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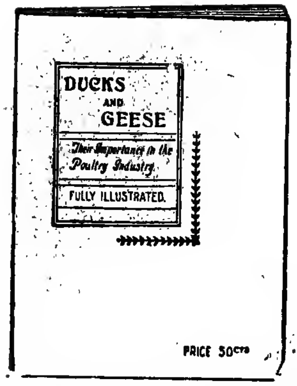
Artificial Incubating and Brooding

A PRACTICAL WORK CONTRIB-
UTED TO BY THE MOST EXPERT
OPERATORS OF INCUBATORS ❧
AND BROODERS IN AMERICA. ❧

(SECOND EDITION.)



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Much valuable matter has been omitted from this table of contents for want of space.

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ARTIFICIAL INCUBATING AND BROODING.

COMPILED BY GRANT M. CURTIS,

EDITOR RELIABLE POULTRY JOURNAL,

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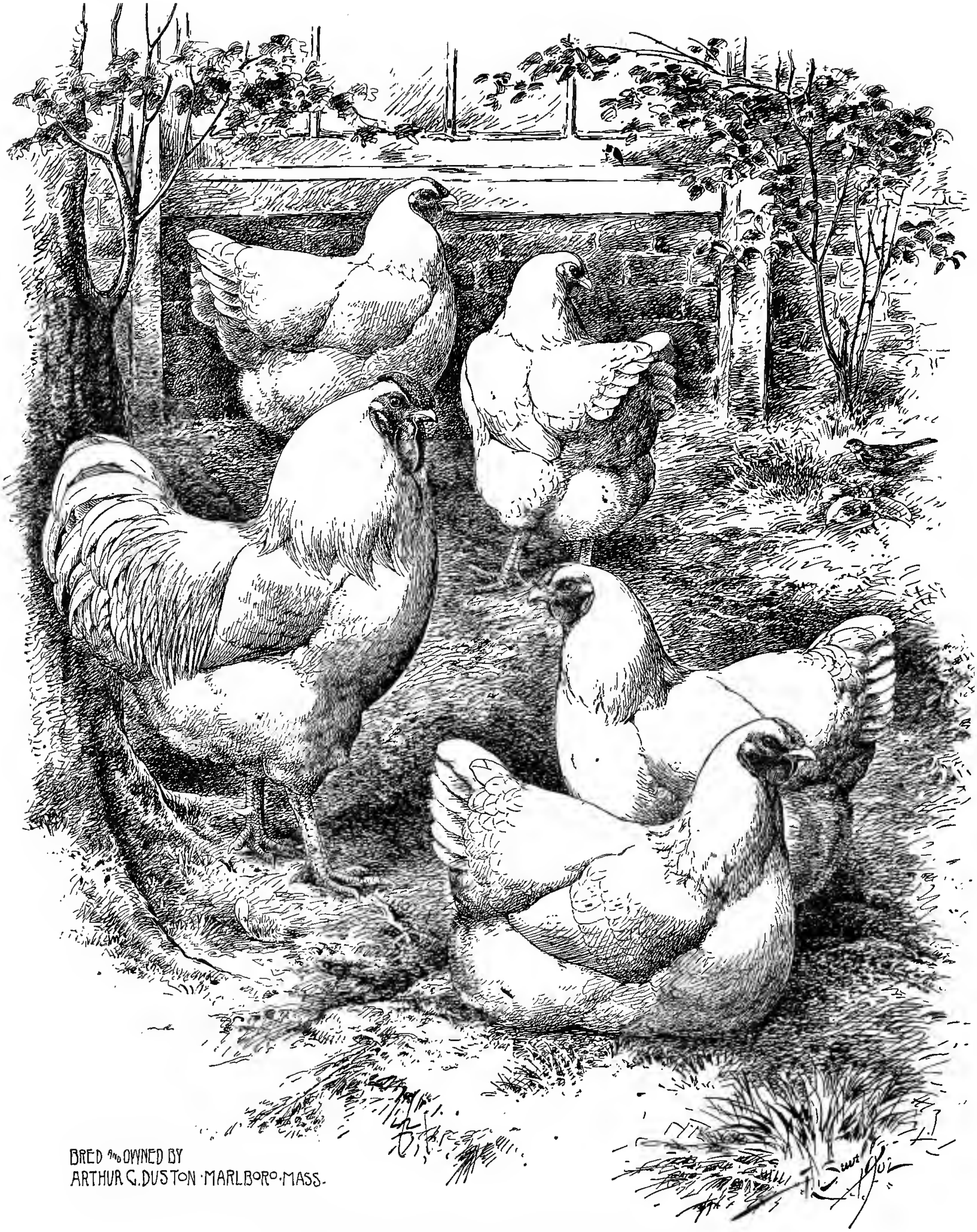
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PREFACE TO SECOND EDITION.

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PRACTICAL and successful incubating and brooding by artificial means have taken giant strides since the introduction to the first edition of this book was written, three and one-half years ago. To-day popular sized incubators are used extensively in every civilized country in the world where poultry is grown for market. We thought we had large poultry plants three and four years ago, and such was the case, but since that time still larger ones have come into existence, including, for example, the famous Loughlin broiler and egg plant at Sidney, Ohio, with an all-the-year-around hatching and brooding capacity of 25,000 to 30,000 chicks; the Spring Lake Poultry Farm, Harrisburg, Pa., a duck ranch and broiler plant with an annual capacity of upwards of 100,000 chicks and ducklings; the Forest Lakes Poultry Farm, Brown's Mills, N. J., with an incubator capacity that calls for 29,520 eggs every three weeks, assuming that the plant is running full; also numerous other plants that closely approach these in the amount of their annual product. Undoubtedly, America still leads in the size and output of its poultry plants, but foreign countries are recognizing the opportunity and embracing it. For example, we have knowledge of one German poultry farm, operated on American lines, that uses fifteen 400-egg capacity American incubators, an English poultry farm that uses twelve, a New Zealand farm that uses twelve and a South African farm that uses an even one hundred, 100-egg capacity incubators, all of American manufacture.

Three and four years ago comparatively little attention was paid to the poultry industry by the general and state governments; to-day the Bureau of Animal Industry is making extensive experiments and issues regularly valuable bulletins devoted to poultry exclusively, and in the neighborhood of thirty state colleges are conducting poultry plants on which they are making a systematic study of poultry and egg production, including the problem of successful incubation and brooding by both natural and artificial means. At several of these colleges annual poultry classes are conducted, with increasing membership, and numerous college graduates in poultry work are obtaining lucrative employment as managers of large market and standard-bred poultry plants.

But the greatest progress made by the incubators and brooders in supplanting the hen as a hatcher and brood mother, has been among poultry fanciers and farmers and farmers' wives. For many years fanciers held aloof from the use of incubators, fearing to trust their valuable eggs to them. At present, on the contrary, there are a number of makes of incubators on the market that are so trustworthy in their operation and so correct in principle that they hatch as good or better chicks than the hen will produce and, as a result, a majority of the poultrymen who produce fancy fowls are using nowadays one or more incubators. Incubators on the farm have become quite common. Where persons used to look askance at a neighbor who made bold to buy a "tin hen," the purchase of an incubator is now looked on as a stroke of enterprise and the possessor of a good incubator is envied.

Incubators are now on sale that are so nearly automatic that five minutes' attention morning and evening is all the time required to take proper care of them. As a matter of fact it is well known and generally admitted that standard incubators will hatch more and better chicks on an average than the hens, and that the chicks will be fully as large and robust. With first-class brooders, or a well built brooder house, a larger percentage of chicks can be raised than by the hen method. This has been demonstrated repeatedly in practically every section of the country. As we write we have before us a report from W. H. Polkinghorn, Holbrook, Mass., who from one incubator holding three hundred and sixty eggs, hatched from March 6th, 1900, to and including February 25th, 1902 (less than two years), a total of 6,773 chicks. Sixteen consecutive hatches obtained during March, April and May, 1900, and during September, October, November and December, 1901—three hundred and sixty untested eggs being used on each occasion—produced the following number of chicks: 286, 254, 301, 234, 221, 251, 186, 280, 296, 257, 293, 271, 289, 277, 245 and 229.

Here we have a glimpse of what can be done with incubators as compared with the hen method. It would require twenty-five to twenty-eight hens to incubate three hundred and sixty eggs, allowing thirteen to fifteen eggs per hen, depending on the size of the hens. The work and worry connected with the care and management of these hens would be considerable, not to mention the fact that it is a difficult matter to obtain large numbers of brooding hens just when they are wanted. The 6,773 chicks that were hatched in this one incubator would weigh, when grown to maturity, no less than 47,411 pounds, allowing six pounds each to the pullets and eight pounds each to the cockerels, and this twenty-four tons and over of poultry meat, sold at ten cents per pound, which is a fair average price east and west, would bring the owner $4,741—quite a snug sum, by the way. Editor.

Quincy, Ill., April 15th, 1902.

INTRODUCTION.

JUST how much the modern incubator and brooder have had to do with the recent rapid development of the poultry industry in this and other countries is hard to estimate, but unquestionably they have been one of the most important factors. Hatching chickens by artificial means is almost as old as history, for it was practiced before the dawn of the Christian Era and has been practiced continuously in Egypt, China, and other oriental countries down to the present day. For an authentic account of how hen eggs are hatched at present by artificial means in Egypt, see report of the United States consul in the following pages. For many years past, in fact, during at least three or four centuries chickens have been hatched artificially in European countries, notably in France, England, Belgium and Denmark; but it has remained for Yankee genius to modernize and practically perfect the present popular-sized incubators and brooders and to devise ways and means of hatching and raising chicks in large numbers by their use on the city lot, the village acre and the ordinary farm.

We are not prepared to say that the use of incubators and brooders in America will eventually do for the American hen what the use of incubatories has done for the Egyptian hen, that is, cause her to abandon altogether the work of hatching eggs and raising chickens, but it is possible and even probable that this will come to pass sometime in the distant future. There is no longer room to doubt that the incubator and brooder method of hatching and raising chickens and ducklings is a marked improvement over the hen method. It is an improvement in the sense that it is cheaper, also that it is better, also that a far greater number of chickens and ducks can be raised by the use of incubators than could profitably be raised with hens. The reader of this book will learn that broiler plants now exist and are being successfully operated in this country where thousands of chickens are raised in limited quarters by artificial means, and that duck ranches exist and are in successful operation where from twenty to twenty-five thousand ducklings are raised each season. All these chickens and ducklings are produced by artificial means and it would be practically impossible to produce the same numbers by the hen method. To do so would require many acres of land, thousands of square feet of buildings and a small army of men and women to take care of the hens. The invention and perfection of the modern incubator has made all this possible, hence so far as the market poultry business is concerned, it owes a very great deal to artificial incubating and brooding.

When we come to consider the incubator and brooder on an ordinary farm, the thought suggests itself and gradually takes the form of actual belief that sooner or later the incubator and brooder will supplant the hen as a sitter and mother in the production of poultry, for it is well known that on hundreds, yes, thousands of farms, taking the country over, the hen method has already been abandoned by the farmer and his wife, and incubators and brooders are being used simply and solely because they do better work with less labor, hence are more profitable. The number of farms on which this condition exists is increasing from year to year and the question arises, "How long will it be before every intelligent and progressive farmer or farmer's wife who wishes to better his or her condition, will find other and more profitable work for the hen to do than to sit on her eggs and serve as mother to a brood of chicks for a number of weeks, and will call to their assistance the artificial hen and mother—modern inventions that are able to do the work better and cheaper?"

We believe it is only a question of a comparatively short time when the American hen will be used almost exclusively for the production of eggs, rather than to have her valuable time wasted in doing work that can be done better and cheaper by artificial means. The hen has a monopoly in the production of eggs. We can hatch her eggs for her and raise her chicks, but we cannot manufacture eggs that will hatch. She will always be in demand, therefore, and it is plainly to the advantage of poultry keepers to use her exclusively for egg production.

According to the United States census of 1890, the average American hen laid at the time the census was taken, less than one hundred eggs per year. It is no doubt true that the average hen on the average American farm, where she is still used as a sitter and mother, does not lay to exceed one hundred eggs during three hundred and sixty-five days, and it is doubtful if she lays more than six or seven dozen eggs during the year. Poultrymen the country over have repeatedly demonstrated that an average flock of standard-bred fowls can be induced to lay from one hundred and fifty to two hundred eggs per year, under proper treatment. When we consider that the hens of America laid during the year 1890 over six hundred million dozen eggs, we obtain a glimpse of the national loss resulting from the average hen laying only seventy-five to one hundred eggs per year, when she could have been induced to lay twice that number. As this country doubles and trebles in population, all such losses as this will be carefully looked after and scientifically treated. This means, if it means anything, that the poultry industry will increase and develop along systematic lines and the incubator and brooder will be called into very general use.

The writer of these lines has traveled upwards of fifteen thousand miles during the past five years, visiting poultry plants, large and small, and during this time has made a careful study of different branches of the poultry business. Long strides have been taken during even this short period until at the present time we hear it commonly said, "The incubator is now a practical success. It is no longer any trouble for a person of ordinary intelligence and careful habits to hatch chickens in large numbers by the use of incubators, but it is not so easy a matter to raise them." This is true, and it isn't true. It is a singular fact that for every three people who can be found who will say, "Oh, yes, I can hatch them all right, but I do not have very good success raising them artificially," one person can be found who will say, "I cannot hatch them so well with incubators as I can with hens, but I can raise them in brooders lots better than I can with hens."

This simply means that different methods are employed, some of which are right and others wrong. It means simply that up to the present time more careful attention has been given by experts to the work of perfecting the incubator and demonstrating the proper use of it, than to the equally important work of perfecting brooders and brooding systems and solving the problems of their successful operation. The fact that many people in this country to-day are hatching eggs under hens and then placing the chicks in brooders to be raised artificially, is complete proof that chicks can be raised in brooders as well or better than they can with hens, and that the brooder is as much an improvement over the hen as an incubator is an improvement on the hen as a hatcher. It is a question merely of knowing how, and that demand is what called forth this book.

The poultry business in all lines is farther developed in the east than it is in the west or south. This is due mainly to density of population, and it is a noteworthy fact that as population increases in density the prices of poultry of all kinds and of eggs steadily increase. This fact argues well for the permanency of the poultry industry. Eggs to-day bring higher prices in New England and in New York and New Jersey than they do in any other sections of the country, and the same is true of all kinds of poultry. In the New England and Atlantic states people are becoming fastidious and are willing to pay a premium for strictly fresh eggs and for extra choice poultry that is placed on the market in an attractive form. There is no room to doubt that these same conditions will obtain in other sections of the country, to the same and even to a greater extent, as the population increases and the American people find time to pay more attention to what they eat. It is our firm belief that the poultry business is destined to increase and improve and grow more profitable in all branches from year to year.

The editor has personally visited many large and successful poultry plants located in the east, including broiler plants, duck ranches and egg farms. We have visited broiler ranches where from ten to twenty thousand chicks are produced each season, duck ranches where from fifteen to twenty-five thousand ducks are produced annually and egg farms where Leghorns and Plymouth Rocks have been induced to average from 175 to 200 eggs per hen per annum in flocks of from 400 to 600. On these large plants incubators and brooders are used exclusively for hatching and raising the chicks and ducklings and here are found the best equipment and the best methods to date. It is a part of the plan of this book to fully illustrate and explain the equipment and methods used on these large and successful plants. We have aimed in this book to provide the most reliable information to date for the guidance of persons who wish to use only one incubator, also those who wish to use anywhere from one to fifty incubators. And the same is true of brooders. We have aimed to provide information explaining the successful use of one or two brooders, also information for the brooding and raising of hundreds and even thousands of chicks and ducklings by artificial means.

It is a surprising fact that up to the time this book appeared a work on the subject of Artificial Incubating and Brooding, that is, a practical work, strictly up-to-date and contributed to by the most expert authorities in the country, had not been published. The writer, who for three years was in the incubator business, and who during nearly five years has been the editor of a popular poultry paper, has felt the need of such a work as this and has been planning to publish one. We wanted a book that would be contributed to by the very best authorities in the country, by men who have spent many years in actual work with incubators and brooders, not only those manufacturing and using them experimentally and practically, but also men who are making their living by the practical use of incubators and brooders. Such a book we now offer to the public, and we are free to say that we believe the reader will find this book to be the most helpful work ever compiled on the subject of Artificial Incubating and Brooding. Not one of the experts on whom we called for assistance refused us, and they have given us freely of their best. What they say can be relied on as the best information and advice to date and it is our earnest hope that every man or woman who reads and follows the instructions given in this work will succeed abundantly and find poultry raising by artificial means a profitable and satisfactory occupation. No doubt when we come to issue a second edition of this work, as is our intention, we shall be able to add to it and improve it, but expense has not been spared to make this first edition both trustworthy and complete. The readers of the book are to be its critics. Any suggestions from them that will tend toward the improvement of later editions will be welcomed and appreciated. The person whose work it has been to compile this book is a firm believer in poultry for profit and is glad to be thus permitted to contribute something toward the advancement of the poultry industry along practical and enduring lines.

Permit us a word of warning to every reader of these lines who may decide to embark in any branch of the poultry business. Be resolved not to spend a dollar of your money foolishly. Too often persons who decide to go into the poultry business count on fabulous profits and proceed to spend their capital on the basis of these hoped for profits. It may be natural enough for them to conclude that inasmuch as the profits are going to be so great, they are justified in spending their money lavishly; but this is a mistaken idea. The profits positively will not be large unless good judgment is used, and it is an old and true saying that one of the best ways to make money is to save it. A dollar saved is a hundred per cent clear profit. No matter how fine a poultry house, it will not induce a hen to lay two eggs a day. It is a significant fact that the men in the poultry business who are making money are those who have made every dollar go as far as possible and have paid more attention to the quality of the goods placed on the market by them than to red, white and blue poultry houses, ornamented with gold rooster weather-vanes. Men of sense can raise more chickens and better chickens in goods boxes, than men of extravagant ideas can raise in "Queen Anne" poultry houses. It is the results you want, not style and show. It is dollars in the bank that you are interested in, not what some local newspaper may say about your poultry plant.

EDITOR.

Quincy, Ill., November 15, 1898.

* * *

EGYPTIAN INCUBATORIES.

Semi-Official Report of the United States Consul at Cairo, Egypt, Setting Forth Interesting and Surprising Facts Regarding the State of Artificial Incubating and Brooding as Practiced at the Present Day in the Country of the Nile.

IT is quite generally known that the hatching and raising of chickens by artificial means was first practiced in Egypt. Says Mr. Cyphers, in the opening chapter of his work, Incubation and Its Natural Laws: "The art of artificially hatching hens' eggs has been known from the remotest ages. Though in Egypt tradition attributes the invention to the ancient priests of the Temple of Isis, it is impossible to determine at what period or to what nation the construction of the first eccaleobion should be credited."

The fact now develops that artificial incubating and brooding is still extensively practiced in Egypt. Some time ago Mr. F. W. Judd, residing at Flint, Mich., wrote to the United States Consul at Cairo, Egypt, asking for information on the subject of artificial incubation in that country to date. In due time he received through the foreign or consular department at Washington a lengthy and carefully prepared report, accompanied by three drawings, outlining the ground plan of a present-day Egyptian incubatory and two sectional views of same, showing the interior construction and arrangement. The semi-official report and drawings are presented herewith under copyright, all rights being reserved:

EGYPTIAN INCUBATORIES.

[REPORT OF THE U. S. CONSUL AT CAIRO.]

[From December, 1895, issue of Reliable Poultry Journal.]

The artificial hatching of eggs has been so long practiced in Egypt that the hens have completely abandoned that part of their work to man. It is a regular industry and the professors form a very close corporation, handing down their secrets from father to son. For three months of the year their time is completely absorbed by constant attention at the incubatories.

Although very successful in the work, they never attempt the hatching except during the months of February, March and April. The minimum temperature in Egypt is reached on the 20th of January; after this it steadily rises, and by Easter the hot weather may be expected. This makes the process difficult and the ovens are therefore closed for the year.

The population of Egypt is very dense, about 700 per square mile. This agglomeration fosters the use of large incubatories, turning out each one from 300,000 to 600,000 chicks each season. In some villages there are from three to five of these establishments. They are generally near to some important market place, and each one apparently in the center of a district of about 50,000 population. That is, each one is the center of a circle having a radius of five miles. It is this density of the population that has allowed this system of artificial hatching to become so very successful. At the same time it must be remembered that there is no other, as the native hen never sits on her eggs.

Another important point is that the hatchers do not attempt to rear the young broods. Forty-eight hours after the chicks emerge from the shell they are scattered over the country; overcrowding is thus prevented. This distribution is effected in a very simple manner. As the incubator is near a market place, word is sent there that on such a day there will be so many young chicks. This news is quickly disseminated among the villages, and on the appointed day the women arrive with their cages and purchase the young chicks, which are generally sold by the hundred for about $1.50 per hundred. There are also a number of brokers or dealers who take the young chicks to the more distant villages. For this they have cages made from the palm branch. They are divided into two stories, each of which is divided by a partition, so that the smaller division only contains about 250 chicks, thus preventing overcrowding. Two such cages will transport each 1,000 young birds, so that a man with a donkey easily manages 2,000 of them, and by nightfall has probably sold the entire lot at a distance of five or six miles from the establishment.

Once in the villages the chicks become the property of the women, who take great care of them during the first week. For two or three days they are kept in cages in lots of twenty or thirty and fed on broken grains slightly moistened. At night the cages are taken into the houses and sometimes covered with a bit of cloth. After these first few days the young birds are strong enough to forage for a living; they are then allowed to roam about freely and at night are kept in a sort of oven placed in a corner of the courtyard. This oven is made of unburnt clay and in shape is like the letter U laid on one side—see drawing. The top is slightly perforated. The entrance is closed by a heavy stone to keep off foxes and other vermin.

When the young chicks are fairly feathered they are plucked perfectly clean and slightly greased. This adds greatly to their health, but detracts much from their beauty. It strikes a stranger as something extremely novel to see hundreds of perfectly naked chickens basking in the sun or running about.

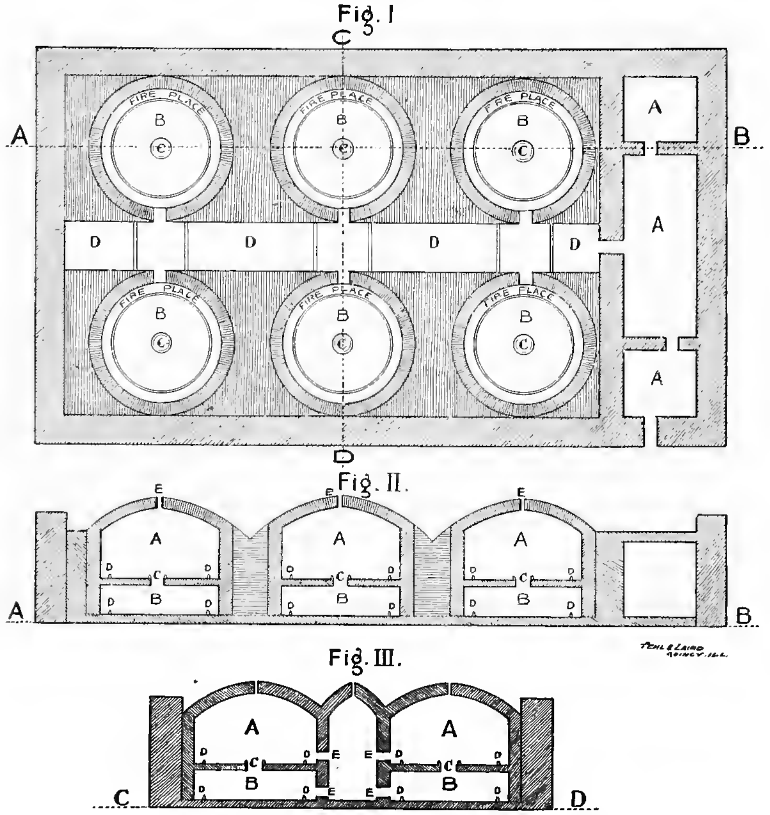
It is difficult to get any exact figures as to the number of these incubatories, but judging from those personally known to me, and their distances apart, I should estimate the number at 150, with an average production of 300,000 per season. This estimate must be well within the mark, as the population of Egypt is nearly 7,000,000, and fowls form a very large part of the Egyptian diet, so that 45,000,000 eatable fowls would be a short supply.

The ordinary form of the incubatories is an oblong 100 feet in length by 60 feet in width, the height varying from 12 to 15 feet. Fig. No. 1, though not drawn exactly to scale, shows the general arrangements. The outer chamber A is divided into three rooms, the middle one masking the entrance to the ovens and thus excluding the outer air. The door leading from A into the central hall is very small. B represents the ovens of the upper tier. C is the man-hole; the attendant stands in this and manipulates the eggs. D D are spaces in the central hall for the reception of the young chicks. These spaces are marked off by ridges of dried mud about nine inches in height. E is the door giving access to the interior of the oven. Around the walls and parallel to it runs a raised ridge six inches in height; between this and the wall the fires are lighted. In the top of the dome is a small aperture about two inches square for the exit of smoke and regulating the heat.

The outer wall, four feet thick, is generally built of sun-dried bricks, the mortar simply mud. The space contained within the walls is divided as shown in Fig. No. 1. The circular ovens are built up and the spaces between them and the wall filled in with bricks and mortar, the same as the outer wall. Each set of ovens, the upper and the lower, is perfectly independent and is covered by a dome having a very small aperture in the crown.

Fig. No. 2 represents the elevation on the line A B of Fig. 1. The height of the lower oven is four feet, that of the upper one nine. The interior diameter between the ridges D D is fifteen feet.

No. 3 represents the elevation on the line C B of Fig. 1, and shows the disposition of the central wall and the doors of the ovens. For this particular incubatory the attendants consist of two men and a boy.



PLANS OF EGYPTIAN INCUBATORY.

(AS FURNISHED BY THE UNITED STATES CONSUL AT CAIRO, EGYPT.)

Key to Illustration; Fig. I—Ground plan. A A A, rooms making entrance to incubatory. B B B, ovens where eggs are hatched. D D, hallway. C C, man-holes admitting attendants to upper tier. Fig. II. Sectional view lengthwise. A A A, upper chambers to ovens. B B B, lower chambers. C C C, man-boles. D D, fire spaces. Fig. III.—Sectional view crosswise—same lettering as for Fig. II.

In the month of January, about the 10th, fires are lighted in all the ovens and on the floor of the central hall. The entire building is thoroughly warmed to a temperature of 110 degrees Fahrenheit. This heat is continued for three weeks, when the temperature is allowed to fall to 100 degrees Fahrenheit.

The fires are at first composed of gelleh or dried cow dung, but when the eggs are placed in the oven coarse broken straw, mostly the joints, and sheep or goat dung is used. The fuel is placed in the trough between the hall and the ridge, and is lighted at one or more places, according to the degrees of heat required. This is the only means of regulating the heat. Thermometers are not used. The attendants endeavor to keep the heat a trifle greater than that of their own skin.

While the oven is being warmed, notice is sent out to the villages that the establishment will purchase eggs on such a date. The country people arrive with large crates containing from one to two thousand. These are purchased outright by the establishment at the rate of $4.00 per 1,000.

The floor of the oven is covered with a coarse mat made of palm leaves; on this a little bran is sprinkled to prevent the eggs from rolling. The attendant changes the position of the eggs twice a day, taking those from near the man-hole and placing them in the outer edge of the circle and vice versa. At the end of six days the eggs are held up one by one towards a strong light. If they appear clear and of a uniform color, it is evident that they have not succeeded; but if they show an opaque substance within, or the appearance of different shades, the chickens are already formed. The bad eggs are removed and the others are continued in their places for four days; at the expiration of this time they are again examined and put back into their places, the same continual shifting from the inner to the outer part of the circle being observed. The doors of the ovens are kept hermetically closed by a small plank well caulked. This is removed in the forenoon and afternoon and once during the night to see that the heat is kept at the proper point.

After the eggs have been fifteen days in the ovens they are daily examined, and so delicate is the touch of the attendant that he can at once distinguish if the eggs be alive by the fact that it should be slightly warmer than his own skin.

At the expiration of twenty-one days the chicks commence to emerge from the shells, the attendants constantly aiding them. They are placed in the spaces D D, Fig. 1, and left to dry for nearly forty-eight hours, but they are not fed. The sale then commences and in a few hours they are spirited away. The temperature in the central hall is maintained at 98 F., and that of the ovens slightly more.

ADDITIONAL FACTS.

"The Egyptian Incubatory of to-day is but a reproduction of the one of thousands of years ago. In all these years the Egyptian breed of chickens has not changed, and the manner of reproduction has remained immutable. Not long since I secured the metal stamp of a chicken, deposited in a tomb over two thousand years ago, and it is a perfect type of the Egyptian fowl of to-day, and when this stamp was struck, artificial incubation was a thing of actual existence in Egypt.

"Not only are the eggs put through the process of incubation more cheaply here than anywhere else in the world, but chicks are reared at an expense past comprehension, while disease and natural death among fowls, because of tireless care, are almost unknown. One man and a boy are the sole attendants of the incubatory I explored. * * * * Think of 234,000 chicks owing life alone to the tender care, in three months' time, of an old man with most defective eyesight and a 16-year-old boy, and some conception may be had of the economies of this Egyptian industry."—U. S. Consul General Cardwell, Scientific Am. Supplement, No. 29, 1890.

STRUCTURE OF AN EGG—DEVELOPMENT OF THE CHICK.

A Chapter Reprinted from "Incubation and Its Natural Laws," by Charles A. Cyphers, Inventor of the Cyphers Incubator and President of the Cyphers Incubator Company.

IT WILL be found essential to a clear and comprehensive understanding of the phenomenon of incubation to have a general knowledge of the embryonic development of the chick. In a fresh egg the following structures are met with:

The most external is the shell, composed of calcareous matter, the particles of which are deposited in a regular manner, designed to give strength and porosity. It consists of an outer thinner and an inner thicker layer, both of which are pierced by vertical canals, opening freely on both the exterior and interior surfaces. Through these canals the interchange of gases between the interior and exterior air takes place, and the chemical process of respiration, though feeble at first, gradually increases in intensity, and is thus carried on during the whole period of incubation.

The appearance to the unaided eye of pores on the surface of the shell is due to the impressions of the villi of the formative membrane, the permeability of the shell by the atmosphere depending on a more minutely porous texture. The first effect of this porosity is the penetration of air between the layers of the lining membrane as the contents of the egg condense by cold and evaporation after it is laid. The air accumulates at the large end of the egg, between the two membranes, and increases in quantity as the other contents become condensed into the tissues of the chick, and contains a larger per cent of oxygen than ordinary atmospheric air.

Charles A. Cyphers.

The air space appears as the egg condenses on cooling and gradually increases in size whether the egg is incubated or not, as the albumen, which contains 78 per cent of water in its composition, shrinks in bulk by evaporation.

Lining the shell is the shell membrane, which is double, there being an outer thicker and an inner thinner one. Over the greater part of the egg the two layers of the shell membrane remain permanently in contact (m, Fig. 1); but at the broad end they tend to separate, and thus to develop between them a space into which air accumulates (a).

Beneath the shell membrane is the white of the egg, consisting of alternate layers of denser and more fluid albumen, the average composition of which may be taken as 20.40 per cent proteid matter; 1.60 per cent saline matter, chiefly sodic and potassic chlorides, with phosphates and sulphates; and 78.00 per cent water.

In a hardened egg a spiral arrangement of the white may be observed, and it is possible to tear off thin layers in a spiral direction from left to right from the broad to the narrow end of the egg.

Two twisted cords, termed Chalaze (ch), composed of coiled membranous layers of dense albumen, run from the **two extremities of the egg to the opposite** portions of the yoke. Their inner extremities expand and merge into the layer of denser albumen (d) surrounding the fluid layer (f) next the yolk. The outer extremities are free, and do not quite reach the outer layer of the white. The function of the chalaze is to keep the yolk more steady in the albumen, and to moderate the effects of any violent movement or rotation of the egg. The interior of each chalaze presents the appearance of a succession of opaque white knots.

The yoke is enclosed in the vitelline membrane (v), a transparent and almost structureless membrane, devoid of pores. It is somewhat elastic, and easily thrown into creases and wrinkles.

On the upper surface of the yolk, and immediately under the vitelline membrane will be seen a little semi-opaque spot about one-eighth of an inch in diameter. This is the blastoderm or germ-spot (bl). The blastoderm of a fertile egg will show an outer white rim, and within that a circular transparent area, in the center of which, again, there is an opacity, sometimes uniform, and sometimes dotted. In an unfertile egg this white disc is simply marked with a number of irregular clear spaces, there being no proper division into a transparent center and an opaque rim. This spot in the infertile egg has sometimes been looked upon as a scar left where the yolk broke from its cell or capsule.

During the descent of the egg along the oviduct of the fowl, where it is exposed to a temperature of 110 degrees or more, the blastoderm undergoes important changes. When the egg is laid and becomes cold, the changes all but entirely cease, and the blastoderm remains inactive until, under the influence of the higher temperature of natural or artificial incubation, the vital activities of the germ are brought back into play, and the arrested changes go on again. The condition of the blastoderm at the time when the egg is laid is not exactly the same in all eggs, though the differences of course are slight. In warm weather changes of the same kind as those caused by actual incubation may take place, to a certain extent, in the interval between laying and incubation.

GLIMPSES OF NATURE'S MARVELOUS WORK.

The Blastoderm is always found to be uppermost, whatever may be the position of the egg, provided there is no restraint to the rotation of the yolk. The explanation of this is to be sought for in the lesser specific gravity of that portion of the yolk which is in the neighborhood of the blastoderm. Though to the naked eye the yolk appears tolerably uniform throughout, a section of the yolk of a hardened egg will show that it is not perfectly uniform, but that there is a portion of it having the form of a flask (wy) with a funnel-shaped neck and a number of layers concentrically arranged around it; which, when the egg is boiled, does not become so solid as the rest of the yolk, but remains more or less fluid. The expanded neck of this flask-shaped space is situated immediately underneath, where it forms a bed on which the blastoderm (bl) rests; while its bulbous enlargement is about the middle of the yolk. This is known as the white yolk (wy), while the great mass of the yolk is composed of what is known as the yellow yolk (yy).

FIG.1.

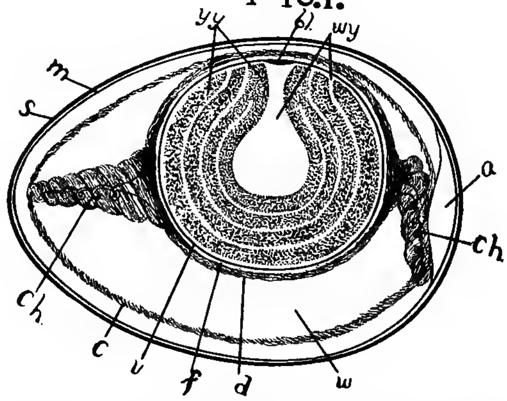


FIG. 1.—Diagrammatic section of an unincubated fowl's egg·*bl*, blastoderm, or germ-spot; *wy*, white-yolk, consisting of a central flask-shaped mass, and a number of layers concentrically arranged around it, the outer layer of white yolk lying immediately beneath the vitelline membrane, and connected with the central mass beneath the blastoderm; *yy*, yellow yolk; *v*, vitelline membrane; *f*, layer of more fluid albumen surrounding the yolk; *ch*, chalaze; *a*, air chamber between the two layers of the shell membrane; *m*, shell membranes, where they lie in contact over the greater portion of the egg; *s*, shell; *d*, denser albumen, which extends around the yolk outside of the internal layer of more fluid albumen; *c*, boundary between the outer and middle portions of the albumen.

The yolk as a whole is of a lesser specific gravity than the albumen, in which it is immersed, while the pressure of the up-floated germ against the shell-wall is moderated by the weight of the denser albumen forming the chalaze. The attachments of the chalaze being a little below the axis of the yolk, it adds its weight to the lower half, and thus helps to make the germinal half the lightest and uppermost. Under ordinary circumstances, rotation of the egg takes place on its long axis, and if a fresh egg be turned round, the blastoderm will keep its position upwards for one turn or a little more, and then, by the twisting of the chalaze, the yolk is carried completely round, and balances itself again with the blastoderm uppermost in its new position. These modifications of the oviparous egg, so delicately wrought, so wonderously endowed, in anticipatory relation to the needs and conditions of incubation, are scarcely conceivable.

In the fertile Blastoderm, as above noted, the naked eye can distinguish an opaque rim of some breadth surrounding a more transparent central area, in the middle of which again is a white spot of variable appearance. The opaque rim is the commencement of what is termed the area opaca; the central transparent portion is in the same way the beginning of the area pellucida.

The blastoderm, which at first lies with its margin resting on the circular wall of flask-shaped white yolk, spreads out, as a thin circular sheet, over the yolk, immediately under the vitelline membrane. Increasing uniformly at all points of its circumference, the blastodermic expansion covers more and more of the yolk, and at last reaching its opposite pole, completely envelopes it. Thus the whole yolk, instead of being enclosed as formerly by the vitelline membrane alone, comes to be also enclosed in a bag formed by the blastoderm, termed the germinal membrane. It is not, however, until quite a late period that the complete closing in at the opposite pole takes place, so that the extension of the blastoderm, or germinal membrane, must be considered as going on during nearly the whole period of incubation. Both the area opaca and the area pellucida share in this enlargement, but the area opaca (Fig. 2, ao) increases much more rapidly than the area pellucida (ap), and plays the principal part in encompassing the yolk.

The circular transparent area, or that part of the area opaca which is nearest the area pellucida, becomes the seat of peculiar changes, which result in the formation of blood-vessels. Hence this part of the area opaca is called the vascular area (va). The embryo (e) itself grows out from the most central portion of the blastoderm, or the central portion of the area pellucida (ap). The head appears first, and several hours later the tail, when the embryo has the appearance of being encased in a small sac and lying in a depression of the yolk-sac, with which it is connected. As incubation proceeds, the embryo gets larger at the expense of the yolk, which is gradually assimilated by nutritive processes.

Within a day or two of the hatching of the chick, at a time when the yolk-sac is still of some size, or at least has not yet dwindled away altogether, and the development of the embryo is nearly complete, the yolk-sac is slipped into the body of the embryo, so that ultimately the embryo with its coverings alone remain.

The general shape of the embryo is due to the direction and slope of the several outgrowths which share in its formation. In addition to this, the tubular sac of the embryo, while everywhere gradually acquiring thicker and thicker walls, undergoes at various points, through local activities of growth in the form of thickenings, ridges, buds or other processes, many modifications of the original outline conferred upon it. Thus, bud-like processes start out from the trunk to form the rudiments of the limbs, and similar thickenings and ridges give rise to the jaws and other parts of the face. By the unequal development of these outgrowths the body of the chick is gradually moulded into its proper outward shape. At the same time other growths take place within the body walls of the embryo, which result in the formation of the heart, liver, lungs, etc.

FIG. 2.

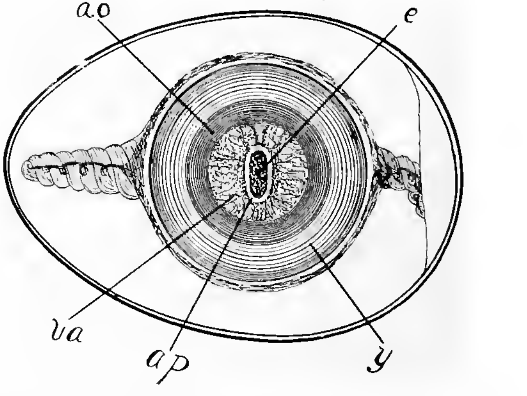


FIG. 2—A fowl's egg after about forty-eight hours incubation, viewed from above, the upper portion of the shell being removed: *y*, yolk; *ao*, area opaca, or that portion of the blastoderm which extends over the yolk as the germinal membrane; *va* the vascular area of the area opaca, the growth of which is somewhat slower than the germinal membrane; *ap*, area pellucida, in the center of which lies the embryo, *e*.

DESCRIBES THE FORMATION OF THE AMNION

Very closely connected with the appearance of the head of the embryo is the formation of the amnion. The amnion is developed in the following way: There first appears, a little way in front of the head, a fold or thin outgrowth running around in front of it (at). As it increases in height it is gradually drawn backwards over the developing head of the embryo (e). The fold thus covering the head is in due time accompanied by similar folds at some little distance behind the tail, and at some little distance from the sides (B). In this way the embryo becomes surrounded by a series of folds of thin membrane, which form a continuous wall all around it. All are drawn gradually over the body of the embryo, and at last meet and completely coalesce (C) all trace of their junction being removed. Beneath these united folds there is, therefore, a concavity or sac within which the embryo lies.

When the several folds meet and coalesce above the embryo, they unite in such a way that all their inner surface goes to form a continuous inner membrane or sac, and all their outer surface a similar continuous outer membrane or sac. The inner membrane thus built up forms a complete closed sac around the body of the embryo, and is called the amniotic sac, or Amnion proper (Fig. 5, am), and the fluid which it afterwards contains is called the amniotic fluid, or liquor amnii. The outer sac over the embryo lies immediately beneath the shell membrane, where it forms the outermost of the embryonic appendages, or chorion.

If the mode of origin of these two sacs, the inner or true amnion, and the outer or false amnion, and their relations to the embryo be borne in mind, the reader will have no difficulty in understanding the course taken in the growth of a very important organ, the Allantois.

The allantois is fundamentally an appendage of the alimentary canal, and is thrown out at the hinder end of the embryo (D, al). It very rapidly pushes its way, by the development of a long tube, into, and fills the space developed between the true and false amniotic sacs, and with the latter it extends from the yolk and albumen (Fig. 3, E, Fig. 5, al), separated from the shell membranes by nothing more than the thin false amnion, and in this position it performs its functions as a respiratory organ, or lungs.

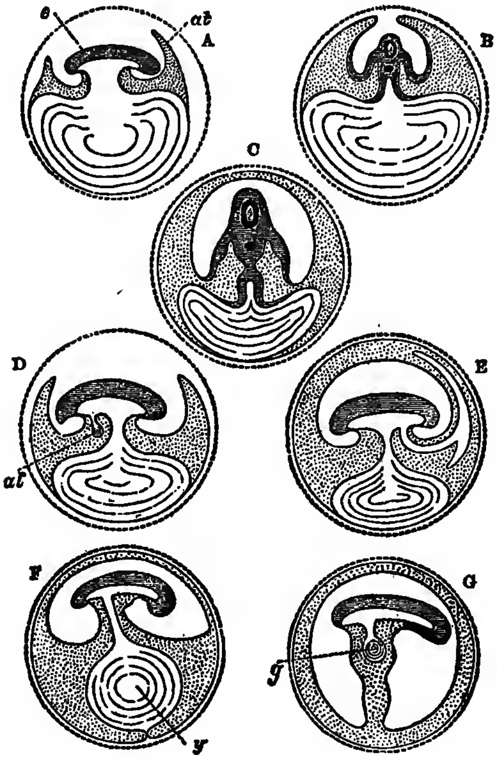
FIRST AND SECOND DAYS OF INCUBATION.

During the first twelve hours of incubation the blastoderm when viewed from above is found to have increased greatly in size. The central white spot, or pellucid area, which at the best is but obscurely marked in the unincubated egg, becomes oval in outline, and very distinct, and contrasts strongly with the outer opaque rim, which has been still more increased, both in distinctness and size. During the latter part of the first day is seen the first definite appearance of the head, and the first trace of the amnion appears in front of it. The vascular area also begins to be distinguished from the rest of the blastoderm.

At the beginning of the second day the head alone projects above the rest of the germ, the remainder of the embryo being simply a part of a flat blastoderm. At about the twenty-sixth hour the tail makes its appearance, being elevated above the level of the blastoderm in the same way that the head was elevated. The amnion, especially the anterior or head-fold, advances in growth very rapidly during the second day, and at its close completely covers the head and neck of the embryo. The tail and side folds of the amnion, though still progressing, lag considerably behind the head-fold.

The first rudiment of the head appears about the twenty-seventh hour, and is of a tubular character, being formed by a longitudinal fold of the vascular layer. For some time it is undivided, being simply a long tube extending through nearly the whole length of the embryo. Although the development has proceeded thus far at about the thirty-fifth hour, no motion is seen in the heart or vessels until the thirty-eighth or fortieth hour.

When the heart first begins to pulsate it contains only colorless fluid mixed with a few globules. A movement of the dark blood in the circumference of the vascular area is at the same time perceived, but it is independent of the construction of the heart, and it is not until a subsequent period that a communication is established between the heart and the distant vessels, and the dark fluid contained in them arrives at the central cavity and is propelled by its pulsations. The formation of fluid goes on in every part of the body, and, when formed it is put in motion by some unknown cause that impels it in the proper direction, until at length it reaches the central formation of fluid, around which is developed a tubular canal afterwards to be modified and changed into a heart. The first movements of the blood are toward the heart, and consequently the first vesicles formed are veins.



Diagrams Illustrating the Development of the Amnion and Allantois.

Fig. 3.—In *A* the embryo (*e*) is seen lying in a depression on the yolk-sac, the folds of the amnion are rising up at either end of the embryo, the fold in front of the head (*at*) being the larger. In *B* the amniotic folds nearly meet, and in *C* they have entirely coalesced. In *D*, which is a little later stage than A, the allantois (*al*) is seen budding out from the intestine. In *E*, which is a stage corresponding with *C*, the alantois is seen extending around the embryo. In *F*, the yolk-sac (*y*) is reduced in size, and in *G* it is being withdrawn into the body of the embryo. The allantois in *F* and *G* is omitted for the sake of simplicity. These diagrams only very roughly indicate the relations of the parts.

The blood-vessels which are first observed in the body of the embryo as well as the vascular area appear formed in insulated points, which gradually coalesce so as to form tubes. No difference is at first observed between the character of the arteries and those of the veins, and they are only to be distinguished by the direction of the currents of blood circulating through them. Subsequently, however (about the fourth or fifth day of incubation), the coats of the arteries begin to appear thicker than those of the veins, and the distinction between them soon becomes evident.

Between the fortieth and fiftieth hours a separation of the heart in parts may be observed, which is effected by a constriction around the middle of the tube and the dilation of the posterior into a ventricular cavity.

EVENTS OF THE THIRD DAY OF INCUBATION.

Between the fiftieth and sixtieth hours the circulation of blood in the vascular area becomes more vigorous; the tube of the heart becomes more and more bent together until it is doubled, so that this organ now becomes much shorter relatively to the dimensions of the body, and is more confined to the portion of the trunk to which it is subsequently restricted.

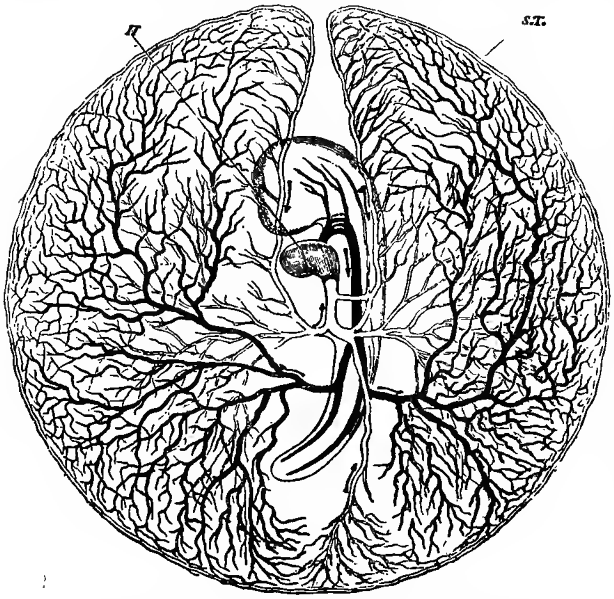


FIG. 4.—Diagram of the circulation of the yolk-sac (vascular area), at the end of the third day of incubation. The veins are marked in outline and the arteries are black. The whole blastoderm has been removed from the egg, and is supposed to be viewed from below, hence the apparent reversal of the sides. *H* is the heart, and *S T* sinus terminalis—the vein which brings the blood back to the heart.

The blood vessels become during the latter part of the second day connected so as to form a complete system, through which a definite circulation of blood is for the first time (consequently some little while after the commencement of the heart's pulsations) carried on.

Nutritive matter is transmitted to the blood by the under surface of the vascular area, and by the blood conveyed to all regions of the body of the embryo, the yolk in contact with it losing its coagulability. As the yolk is absorbed, it is in turn replenished at the expense of the white. The absorption, once begun, goes on so actively that by the end of the third day the decrease of the white is very striking.

The blastoderm is now spread over about half the yolk, the extreme margin of the germinal membrane reaching about half way towards the pole of the yolk opposite to the embryo. The vascular area, although still increasing in size, is much smaller than the outer opaque area, being in average sized eggs about as large as a quarter. Still smaller than the vascular area is the pellucid area, in the center of which lies the rapidly growing embryo.

During the third day the vascular area is not only a means for providing the embryo with nourishment from the yolk, but also insomuch as by the diminution of the white it is brought close under the shell, and, therefore, fully exposed to the influence of the atmosphere, serves as the chief organ of respiration.

The embryo is almost completely covered by the amnion. At the close of the day the several amniotic folds will have met along a line over the back of the embryo. Their complete coalescence and the obliteration of their line of junction will, however, not take place until the following day.

During the third day a most remarkable change takes place in the position of the embryo. Up to this time it has been lying symmetrically upon the yolk with the part which will be its mouth directed downwards. (If an egg be placed with its broad end to the right of the observer, the head of the embryo will in nearly all cases be found pointing away from him. Duval found 163 out of 166 examined, in this position.) It now turns around so as to lie on its left side. This remarkable change of its position is almost invariably completed on the third day. Coincidentally with the change of position the whole embryo begins to be curved on itself. This curvative of the body becomes still more marked on the fourth day.

THE FOURTH DAY OF INCUBATION.

On opening an egg in the middle or towards the end of the fourth day a number of points in which progress has been made since the third day are at once apparent. In the first place, the growth of the embryo has been very rapid, so that its size is very much greater than on the previous day. In the second place, the white of the egg is still further diminished, the embryo lying almost in immediate contact with the shell membrane. The germinal membrane embraces more than half the yolk, and the vascular area is about as large as a half-dollar. Corresponding to the increased size of the embryo there is a great increase in the activity of the blood circulating in the vascular area.

The amnion becomes increasingly conspicuous. It is now seen as a distinct covering, obscuring to a certain extent the view of the body of the chick beneath, and all trace of the junction of its folds are by this time lost. As yet there is very little fluid in the amniotic sac proper, so that the dry amnion lies close upon the embryo. The tail, which commences to be noticeable during the third day, is during this day increased very much, and the somewhat curved tail forms quite a conspicuous feature of the embryo. The general curvature of the body is also increasing, and as the result of these various flexures the embryo has very much the appearance of being curved upon itself.

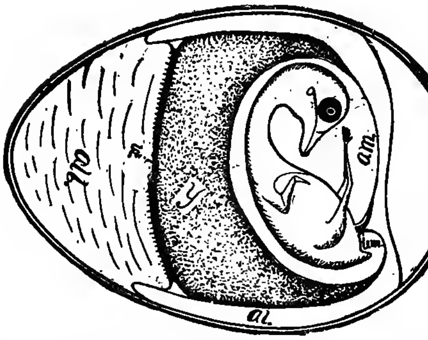


FIG. 5.—A diagrammatic section through the fowl's egg about eleven days incubated. *Al*, cavity of the allantois; *alb*, albumen; *am*, cavity of the amnion; *um*, umbilicus, or small hollow tube connecting the embryo with the amnion, yolk-sac and allantois. The outer covering of the umbilicus is formed by the amnion, and is continuous with the body wall of the embryo. Through this tube passes that of the allantois, and also that of the yolk-sac. By means of the latter the walls of the alimentary canal are continuous with the membrane covering the yolk-sac, and the interior of the canal is continuous with the inside of the yolk-sac. At a comparatively early period the canal of this stalk becomes obliterated, so that the material of the yolk can no longer pass directly into the alimentary cavity, but has to find its way into the body of the chick by absorption through the blood vessels.

When in the last days of incubation the greatly diminished yolk-sac with its germinal investment is withdraw into the rapidly enlarging abdominal cavity of the embryo, the walls of the abdomen close in and unite without any regard to the amnion and the shriveled, emptied allantoic investment, which are cast off as no longer of any use.

The distinct appearance of the limbs must be reckoned as one of the most important events of the fourth day. The allantois becomes for the first time conspicuous on this day, though the first appearance of the rudiments of it appear on the third. Soon after its appearance the allantois may be easily recognized as a pear-shaped vesicle, connected with the under surface of the alimentary canal by a long hollow stalk. It does not, during the third day, project beyond the body of the chick, but on the fourth day begins to pass out on its way to that space between the external and internal folds of the amnion. In this space it spreads out and eventually encloses the whole contents of the egg beneath the shell membrane (Fig. 6, al). On the first half of the day it is very small, and its growth is not very rapid. In the latter half of the day its growth becomes more rapid, and it forms a very conspicuous object in a chick of that date. At the same time its blood-vessels become important.

THE FIFTH DAY OF INCUBATION.

On opening an egg about the middle of the fifth day the observer's attention is not arrested by any new features, but he notices that the progress of development, which was so rapid during the latter half of the fourth day, is being continued with undiminished vigor. The allantois, which on the fourth day began to project from beneath the embryo, has grown very rapidly. and now stretches far over the right side of the embryo (which it will be remembered is lying on its left side) in the cavity between the two amniotic folds. It is very vascular, and already serves as the chief organ of respiration.

The germinal membrane has spread over the whole of the yolk sac, and the yolk is thus completely enclosed in a bag whose walls, however, are excessively delicate and easily torn. The vascular area extends over about two-thirds of the yolk. The embryo remains excessively curved, so much so, indeed, that the head and tail are nearly in contact. The amnion at its complete closure on the fourth day very closely invested the body of the chick, the true cavity of the amnion was then, therefore, very small. On the fifth day fluid begins to collect in the cavity, and raises the membrane of the amnion to some distance from the embryo. The cavity becomes still larger by the sixth day, and on the seventh day it is of very considerable dimensions, the fluid increasing in it.

By the seventh day very obvious movements begin to appear in the amnion; its slow vermicular contractions creep rythmically over it. The amnion, in fact, begins to pulsate slowly and rythmically, and by its pulsation the embryo is rocked to and fro in the egg. Similar movements are also seen in the allantois at a considerably later period. The growth of the allantois has been very rapid, and it forms a flattened bag covering the right side of the embryo, and rapidly spreading out in the direction between the primitive folds of the amnion, that is, between the amnion proper and the false amnion, or chorion. It is filled with fluid. so that in spite of its flattened form its opposite walls are distinctly separated from each other.

The vascular area has become still further extended than on the previous day, but with a corresponding loss in the definite character of its blood-vessels. The sinus terminalis (thin red line around the extreme margin of the vascular area, and nearly completely encircling it) has, indeed, by the end of the seventh day lost all of its previous distinctness, and the vessels which brought back the blood from it to the heart are no longer to be seen. The yolk is not so fluid as on the sixth day, though it continues to absorb the white of the egg, which is diminishing rapidly. The liquid thus absorbed by the yolk from the albumen serves for the formation of the amniotic and allantoic fluids.

EIGHTH, NINTH AND TENTH DAYS.

During the eighth, ninth and tenth days the amnion does not undergo any very important changes. Its cavity is still filled with fluid, and on the eighth day its pulsations are at their height, henceforward diminishing in intensity. The allantois now spreads out over the greater part of the yolk-sac as a flattened bag filled with fluid, and serves as the chief organ of respiration. Hence it is very vascular. the vessels on the right side of the bag, which is turned to the chorion and shell, being especially large and numerous. The yolk now begins to diminish rapidly in bulk. The yolk-sac becomes flaccid, and, on the eleventh day, is thrown into a series of internal folds abundantly supplied with blood-vessels. By this means the surface of absorption is largely increased, and the yolk is more and more rapidly taken up by the blood-vessels, and in a partially assimilated condition transferred to the body of the embryo.

By the eleventh day the abdominal walls, though still looser and less formed than the walls of the chest, may be said to be definitely established, and the loops of intestine, which have hitherto been hanging down, are drawn up into the abdomen. The body of the embryo is therefore completed, but it still remains connected with its various appendages by a narrow umbilicus (Fig. 5, um) in which run the stock of the allantois and the solid cord suspending the yolk-sac. The allantois still growing rapidly, completely surrounds the whole contents of the egg, except at the pole opposite to the embryo, where for some little time a small portion of albumen remains unenclosed; at this spot the diminished white of the egg adheres as a dense viscid plug.

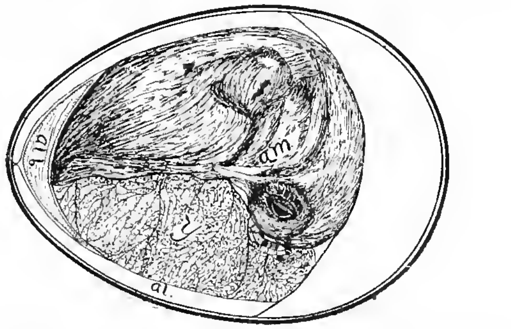


FIG. 6.—A diagrammatic section through a fowl's egg about sixteen days incubated; *al*, cavity of the allantois. The allantois now completely envelops the embryonic and yolk-sacs, and the remaining portion of albumen, *alb*. The amnion, *am*, is loosing fluid, and very closely developes the embryo, while the yolk, *y*, is seen folded over it. The allantois becomes thinner and thinner as incubation progresses, so that at the last its two walls lie in direct contact, the fluid and cavity entirely disappearing.

The allantois lies over the embryo, close under the shell, being separated from the shell membrane by nothing more than a thin membrane formed out of the outer primitive fold of the amnion and the remains of the vitelline membrane. With this membrane the allantois partially coalesces, and in opening an egg at the latter stage of incubation, unless care be taken, the allantois is in danger of being torn in the removal of the shell membrane.

On about the sixteenth day the allantois is carried right over the pole of the yolk opposite the embryo, and is thus completed. Deposits of urates now become abundant in the allantoic fluid. The loose and flaccid walls of the abdomen enclose the space which the empty intestines are far from filling, and on the nineteenth day the yolk-sac, diminished greatly in bulk, is withdrawn through the umbilicus into the abdominal cavity, which it largely distends. Outside the embryo there remains nothing now but the highly vascular allantois and the practically fluidless amnion.

By the sixth or seventh day the flexure of the body has become less marked, so that the head does not lie so near to the tail as on the previous days, and at the same time a more distinct neck makes its appearance. Though the head is still disproportionately large, its growth now ceases to be greater than that of the body.

WHEN THE FEATHERS BEGIN TO SHOW.

So early as the ninth or tenth day the sacs containing the feathers begin to protrude from the surface of the back as papillae, especially prominent at first along the middle line of the back, from the neck to the rump and over the thighs, the sacs of the tail feathers very conspicuous. On the thirteenth day these sacs, being generally distributed over the body, and acquiring a length of a quarter of an inch or more, appear to the naked eye as feathers, the thin walls of the sacs allowing their contents, now colored according to the breed of bird, to shine through. They are still, however, closed sacs, and, indeed, remain such even on the nineteenth day, when many of them are of considerable length.

On the eighth day a chalky-looking patch is observable on the top of the nose. This, by the twelfth day, has become developed into horny, but still soft, beak. On the thirteenth day nails are visible at the extremities, and scales on the remaining portions of the toes. These on the sixteenth day become harder and more horny, as does also the beak. By the thirteenth day the cartilaginous skeleton is completed, and the various muscles of the body can be made out with tolerable clearness.

Ossification begins on the eighth or ninth day. As early as the sixth day movements may be seen in the limbs of the embryo upon opening the egg. We may conclude from this fact that spontaneous movements occur from time to time in the unopened egg. They cannot, however, be of any great extent until the fourteenth day, for, up to this time, the embryo retains the position in which it is formed, viz., that with its body at right angles to the long axis of the egg.

On the fourteenth day a definite change of position takes place; the chick moves so as to lie lengthwise in the egg, with its head opposite the chorion and shell membrane where they form the inner wall of the rapidly increasing air chamber at the broad end. By the eighteenth day the fluid in the amniotic sac, in which the embryo lies, has entirely disappeared, and the chick is breathing the air which it contains. The pulmonary circulation, which has been gradually developing since the third day, increases in activity, and the circulation of blood in the allantois correspondingly diminishes.

By the twentieth day the fluid in the allantois has entirely disappeared, and the circulation of blood in the allantoic vesicles is quite sluggish. The chick now thrusts its beak through its coverings, and breathes the outer air. At this time the blood entirely ceases to flow through the umbilical arteries into the allantois, and the pulmonary respiration now becomes the sole means of its aeration. The allantois therefore dries up, and the umbilicus becomes completely closed. In from six to ten hours from the time of first breathing the outer air, the chick, breaking the shell around the broad end of the egg with rapid blows of its beak, casts off the dry remains of the amnion and allanois, and quits its primitive home.

* * *

NATURAL LAWS OF INCUBATION.

Semi-Scientific Treatise on the Natural Laws and Conditions Which Must be Conformed to in Order to Achieve the Maximum of Success in Hatching Eggs by Artificial Means.

BY CHARLES A. CYPHERS,
Author of "Incubation and Its Natural Laws," Inventor of the Cyphers Incubator, and President of the Cyphers Incubator Company, Buffalo, N. Y.

THE first factor to be considered in artificial incubating and brooding is good eggs. The possibilities of successful incubation are far ahead of those of successful brooding, as we can now place eggs under so nearly perfect conditions, that we can do quite as well as the old hen in hatching, and even get out a larger percentage than an average lot of hens; but in brooding, the old hen seems to be still in the lead, under favorable conditions. The incubation of an egg is a mechanical process, and if the physical laws which control it are thoroughly understood, we can supply the needs perfectly by mechanical means, but in the artificial brooding of the chick we substitute an inanimate for an animate body, and can not supply the keen instinct which old biddy displays in caring for the individual wants of her brood, and especially of the weaker members of it. We can supply the mechanical requirements of hatching, because they are practically one—we guard against outside influences and keep a certain fixed condition within a limited body a few feet square. In brooding and raising chickens, we cannot make an animate body to move around with them, to let the strong forge ahead, and coddle and feed the weaker ones and nurse them along until they have vitality and pugnacity enough to fight their way to maturity.

The vicissitudes of temperature outside of the brooders, coupled with a disinclination of a part of the brood to eat and care for themselves are what make artificial raising so hard, and it is impossible to make an animate body to coddle these weaklings along. It is very obvious, therefore, that the smaller number of weaklings we have, the larger will be the percentage we may expect to raise. While there are machines that are so poorly designed to meet the proper requirements of incubation that the chicks do not mature well ripened, no machine can hatch a strong, vigorous chick from an imperfect egg, so I say, the egg is the first thing to be looked to, to see that we have strong chicks to brood after they are hatched, and not a lot of weaklings that will need coddling and nursing, for it is the percentage we raise successfully that tallies on the side of profit.

Various manufacturers have put out machines that can but imperfectly do the work for which they were intended, but are yet capable of hatching a percentage of the best eggs, and when their customers complain of poor hatches, the whole blame has been thrown on the eggs. If the chicks could not be raised in their brooders it was the fault of the eggs and not the brooder, which might be of ill-design. The old operator knows by experience just how far the trouble should be laid to the eggs, the incubator or the brooder, as he compares the present with the past, and he thus has the key to the situation. The young operator, the beginner, however, has no past experience with which to compare the present, and he often secures poor tools to work with, from the egg to the machine with which he attempts to incubate it, and the brooder to which the chick is intrusted. The consequence is that after being buffeted from pillar to post for a season he finds at the close that he has a handful of miserable looking chickens, which feel more miserable than they look, a depleted bank account (if he had one), a lot of bills to meet and nothing with which to pay them. Then the cry goes up in the neighborhood, "So and so failed in the chicken business. There is nothing in it." So it is well for the beginner to select his tools with care if he wishes to succeed. That he can succeed is proved by the success of hundreds who are making money out of the business.

When designing to secure good eggs, we need to go back of the care and feed, to the blood. We can not take a flock of inbred scrubs, the brothers and sisters of which have been interbreeding for years, and expect to secure eggs that will hatch strong chickens. With a perfectly constructed machine we can coax a percentage of these eggs to hatch, but we have no animate body to coax and coddle the little weaklings into trying to make a live of it.

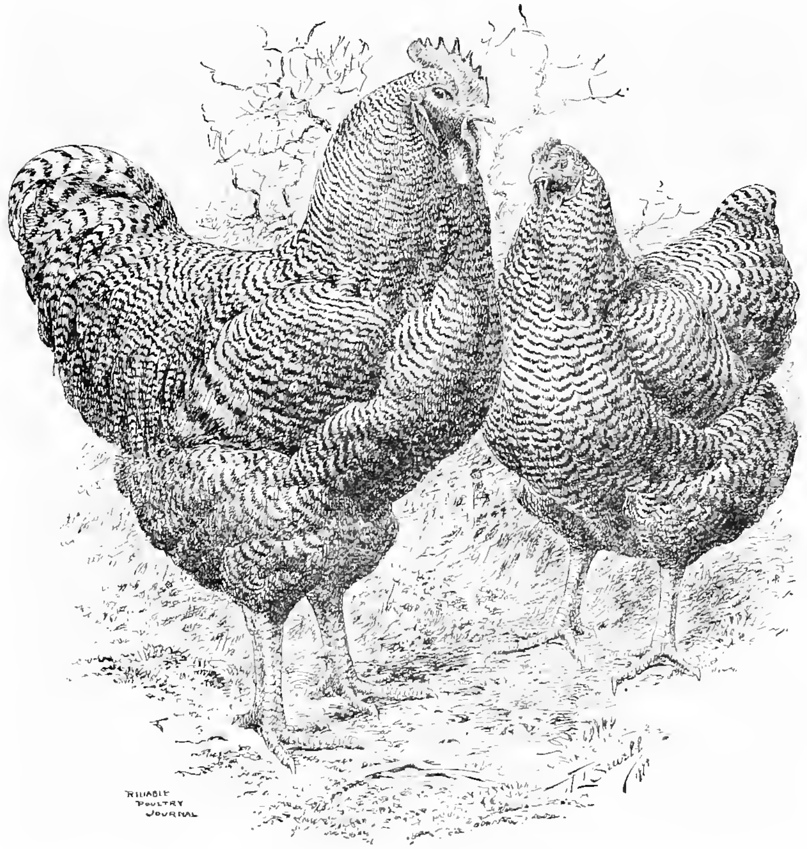
In selecting the breeders, do not haggle too much on price, neither try to buy too many fancy points, but secure your stock from some breeder who has for years been breeding for strong, vigorous birds, and who has raised his flocks on free range. This latter factor is of as much importance as good blood. There is a wide difference in the eggs from stock raised on free range and those from the hen that was restricted and pampered when growing. It is often necessary to confine the layers to a limited run during the breeding season, and just as good results can be secured, provided the stock was allowed free range when growing.

Having selected a good vigorous pen of birds, our next step is to keep them in the best of health by proper care and feeding. It is not necessary to erect elaborate laying houses, but it is necessary to have a good warm roosting room, not so very large, and a goodly-sized scratching shed, open to the south, to make a warm shelter out of doors—a playground for the birds, as it were, where they can get fresh air and exercise during the stormy weather of the winter month, without being exposed to the cold rains and colder winds.

Plans are now designed for building correct laying houses so cheaply that there is no excuse for quartering breeding stock in ill-conditioned buildings. If you can not start in the business with the first elements of success in your favor, it is best not to start at all. It is very often not so much the lack of money, as a very few dollars, coupled with a large stock of push and energy, will make and keep things right from the start.

Having our layers properly housed we need to feed them in such a manner that their digestive organs will be kept in good working order and the material necessary to health and egg production be supplied. First we need fresh water, as without a large percentage of liquid the vital functions can not be carried on. It not only aids digestion and assimilation, but it helps to wash out the impurities of the blood caused by the chemical changes going on in the animal economy. After water comes grit, as without grit no species of bird that feeds on grain can digest its food properly, a large proportion of it going to waste.

Corn should form at least one-third of the food. Corn is the most easily digested grain food, and forms the basis for egg production, when aided by the proper accompaniments, green food and meat. Wheat has good feeding value and should form another third of the grain ration. Green food, such as boiled clover, should form about twenty-five per cent. Clover is one of the most healthful stimulants that can be given fowls. It should be cut about one-fourth inch long, not ground in powder, as one of its values is the bulk it gives to an otherwise soggy mash. Cabbage, turnips and potatoes can be fed as a change. Eight to ten per cent meat scraps should be given. Green bone contains a large percentage of fat, in not as digestible a form as secured in corn, while lean meat, such as horse flesh or pressed beef scraps, gives the nitrogenous food that meat is designed to supply. Both green food and meat are necessary to perfect egg production, and eggs from confined stock not supplied with them are worthless for incubation. During the cold weather care should be taken that the eggs are not chilled. Only perfectly formed eggs should be selected for incubating. Thin-shelled or odd, irregularly-shaped eggs should be sent to market. The very small and very large ones should also be discarded. Having secured the best eggs possible, select an incubator that meets the natural conditions. The two principal factors of the incubation of an egg being warmth and fresh air, we will consider something of their properties. It must be remembered that from the first moment the germ commences to incubate it becomes a living animal and is subject to the same laws which control growth after exclusion, though limited in its powers and dependent upon external influences.



BARRED PLYMOUTH ROCKS.

Standard Weights { Cock, 9½ pounds; Cockerel, 8 pounds.
Hen, 7½ pounds; Pullet, 6½ pounds.

Characteristics—Cost of raising to maturity, $0.75. Annual cost of keeping, $0.90. Average egg yield per year, 175. Average number of eggs to pound, 8½. Hardy constitution. They are good as foragers; can stand confinement; are fine as sitters and good as mothers. Grain and flavor of flesh good.

NATURAL INCUBATION.

In order to understand the requirements of artificial incubation we shall need to first consider the observed facts in relation to the natural processes, by a comparison of which the general principles common to all may be deduced. If left to herself a hen will prepare a shallow receptacle for the eggs, to aggregate them in a space that may be covered by the incubating body and will keep in the warmth.

When a hen becomes broody after laying a clutch of eggs the plexus (network or interlacement of blood-vessels) of the organ of incubation is developed, which consists of an arterial plexus ramifying beneath the integument of the abdomen, and form, by their unions, a rich network of vessels which becomes truly extraordinary in the time of hatching. Thus the warm blood is brought to the surface which is opposite the eggs, bringing the latter to a temperature that approaches more nearly to that of the blood of the fowl than they would otherwise be brought.

After this preparatory stage a hen sits on the eggs more or less constantly for about twenty days, from time to time moving them about in the nest, probably adjusting them to her own comfort. As a rule, the larger number of a sitting of eggs will become arranged in a circle, with the broad ends forming the circumference. This seems to be due to the hen's turning or shifting her position on the eggs, and to the shape of the body of the hen and of the egg itself. During the latter stages of incubation the broad end becomes very slightly elevated, which is due in part to the nest becoming more hollow, and to the bulk of the contents of the egg being situated in the small end, making that portion of it the heaviest.

In settling on the nest the hen makes a slight movement with the body from side to side, which partially separates the eggs and forces them out in the feathers, only a comparatively small surface of each eggs coming in contact with the incubating body. Over a greater part of that portion of the egg opposite the hen's body a layer of down and feathers intervenes, which also covers the outer end and the remaining portion of the surface. Many times the feathers on the abdomen either fall or are plucked off during incubation, and the eggs are then brought into direct contact with the warm body.

The number of times the hen will leave her nest, as well as the period of remaining away from it, varies with different hens, and the state of the weather. In very warm weather the hen often rises in the nest and throws her feathers out to cool her body, thus partially uncovering the eggs. If the weather be excessively warm during the latter stages of incubation the chicks will often be found dead in the shell. For a few hours before first breaking the shell the labored breathing of the chicks can be heard, with an occasional pip and chirp, and the eggs sweat. After exclusion the chicks at first sweat profusely, are highly sensitive to the slightest current of air, and huddle close to the hen's body for warmth.

In natural incubation the eggs are thus placed beneath a heat-generating body, and covered in with down and feathers. In this position they are warmed principally by conduction, and secondarily by diffusion or conveyance—both interior and exterior of the shell. An unincubated egg is a very poor conductor of heat. The shell, however, is one of the very best conductors, and to it the more uniform heating of the egg is at first due. In illustration, if a piece of muslin be smoothly wrapped around an egg, it may be held in the flame of a lamp until the whole egg is hardened without the muslin burning, so rapidly does the shell conduct the heat away.

In addition to the high conducting power of the shell, through the rapid development of the vascular system (consisting of blood vessels), the blood circulation soon aids in the distribution of the external warmth. Moreover, in natural incubation we have supplementary external aids of considerable value; i. e., the tendency of the heated air to diffuse downward through the feathers covering in the eggs, as well as outward, and of the feathers to hold, entangled around the eggs, a comparatively large volume of warm air. The air in contact with the heating body becomes warmer than the outside atmosphere, and tends to diffuse outward through the feathers, cooler air taking its place, though any rapid movement is held in check by frictional resistance. Thus it is seen that the heat is to a large extent retained around the eggs by the maze of fluffy feathers.

TEMPERATURE OF THE EGGS.

I find the temperature of the eggs will average up at the end of the first day of incubation at about 97½ degrees; at the end of the second day at 98¼, and from this time on will gain uniformily one-fourth degree a day until the end of the eleventh day, having a temperature at that time of about 100½ degrees. During the next two days the temperature rises to 101½ or 102 degrees, and remains more or less stationary at 102 until the end of incubation.

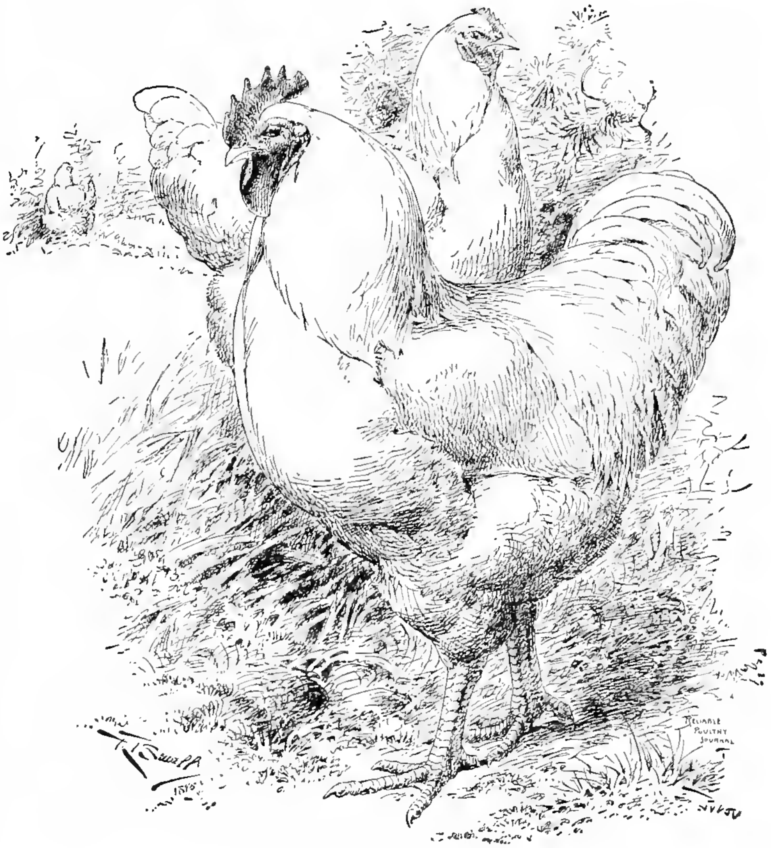
The eggs tested were from a mixed lot of hens, and the sitters were common barnyard fowl. The figures given are the average of from five to eight registrations each, and represent, for the most part, the temperature of the great mass of the egg only, the temperature of the blood in the vascular system probably being somewhat higher.

The thermometer used was made especially for the purpose, and contained the least possible mercury, and had the largest amount of surface exposure that it was practicable to make. The instrument was so delicate that it would register from four to six degrees above the temperature of the air when exposed to the radiant heat an inch from the palm of the hand, and was sufficiently delicate to show a difference of half a degree in different parts of the egg.

GETTING THE TEMPERATURE.

In testing, the eggs were removed from the nest and wrapped in warm flannel; a small hole, about one-eighth of an inch in diameter, was cut in the broad end of the egg, and the thermometer, already warmed to 98 degrees, was quickly introduced into different parts of the egg without mixing the contents any more than possible. A correction of two-fifths of a degree was allowed, which probably more than covered the amount of heat lost. A difference of half a degree could be detected between the temperature of the center of the egg and the parts near the surface, while one side seldom registered as much as one-fourth degree higher temperature than the opposite. Only eggs that were well covered were taken, and only those containing live germs counted. Infertile eggs ranged from 96 to 98 degrees throughout the batch.

The one or two fertile eggs left in the nest in each sitting hatched by or before the close of the twenty-first day, and in all but three dead germs were found. All the eggs showed a remarkably uniform temperature at the different periods, seldom varying as much as one degree either side of the figures given.



WHITE PLYMOUTH ROCKS

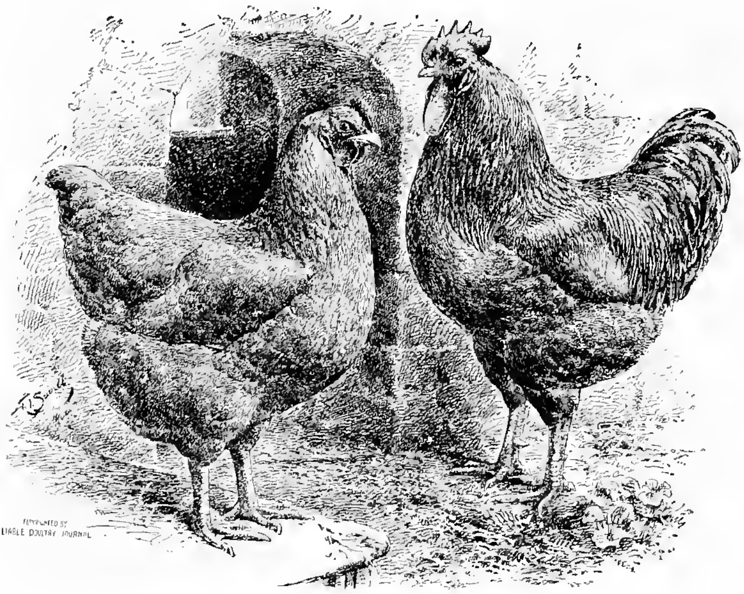
STANDARD WEIGHTS { Cock, 9½ pounds; Cockerel, 8 pounds.
Hen, 7½ pounds; Pullet, 6½ pounds.

Characteristics—Cost of raising to maturity, $0.75. Annual cost of keeping, $0.90. Average egg yield per year, 175. Average number of eggs to pound 8½. Hardy constitution. They are good as foragers; can stand confinement; are fine as sitters and good as mothers. Grain and flavor of flesh good.

Notwithstanding the delicacy of the thermometer used, it is probably impossible to get the temperature in the region of the germ-spot, or later of the blood in the vascular system before the twelfth day, with so crude an instrument as a thermometer. The egg undoubtedly attains a superficial temperature at first of 100 degrees over that portion which is in immediate contact with the incubating body, and during the first days of incubation the germ must partake of that temperature to a greater or lesser extent, as it lies immediately beneath the shell in the neighborhood of that portion which is nearest the source of warmth.

THE MAXIMUM TEMPERATURE.

The great body of the egg, however, does not reach its maximum temperature until the twelfth or thirteenth day. By this time the allantois (a membranous sac-like appendage, for effecting oxygenations and other changes in the blood, developed from the hinder parts of the alimentary tract in the embryo of mammals, birds and reptiles) extends three-fourths of the way around the egg, and its blood-vessels lie immediately beneath the chorion (the membrane which encloses the contents of the egg after incubation starts) and shell membranes, while the vessels of the yolk-sac have nearly enclosed the yolk. It will thus be seen that the heat applied to any one portion will at this time be rapidly diffused by the blood throughout the contents of the egg.



BUFF PLYMOUTH ROCKS.

STANDARD WEIGHTS { Cock, 9½ pounds; Cockerel, 8 pounds.
Hen, 7½ pounds; Pullet, 6½ pounds.

Characteristics—Cost of raising to maturity, $0.75 Annual cost of keeping, $0.90. Average egg yield per year, 175. Average number of eggs to pound 8½. Hardy constitution. They are good as foragers: can stand confinement; are fine as sitters and good as mothers. Grain and flavor of flesh good.

TEMPERATURE OF THE HEN.

If during the first few days of incubation we place a suitable thermometer beneath the hen, in about the same position as the eggs are placed, there will be imparted to it a temperature of about 101 degrees only, although a glass placed in the rectum will register from 109 to 110, and if the hen is killed without bleeding, an opening quickly made through the side, and a delicate thermometer thrust into the region of the heart, it will register from 112 to 112½ degrees. By the end of the first week of incubation the temperature in the rectum will be about 109; by the end of the second week it will have fallen to 108; and sometimes by the end of the third week to 106 degrees. One hen with a rectum temperature of 106 at the end of incubation was killed the fourth day following, and was found to have a temperature in the region of the heart of 110.

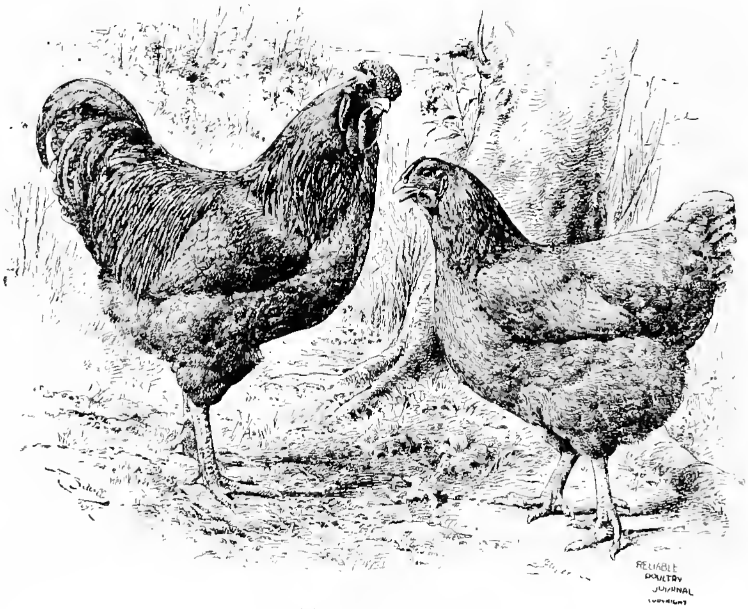
RELATIVE POSITION OF THE EGG.

During the early stages of incubation the eggs cannot be said to be, to any great extent, in direct contact with the incubating body, as a layer of down feathers intervenes; but, as incubation progresses, the feathers covering the abdomen either fall or are plucked off; so that, notwithstanding the greater body temperature of the hen at the commencement of incubation, the temperature of the surface which imparts the warmth to the egg is not much inferior during the latter stages of incubation to that of the earlier, owing to the change in the relative position of the egg, and to the greater advancement of the incubating plexus, which brings more and more warm blood to the surface of the abdomen.

The eggs themselves develop very little heat up to the eleventh day. By the eleventh day the structural development of the chick is about complete, and from this time on less external warmth is required to maintain its temperature, a small amount of heat being now developed by the chick in the absorption and oxidation of the remaining nutrient material. The chick is growing rapidly, and some little excretion is appearing in the allantoic fluid (fluid enclosed in the allantois) and in the intestines.

HIGHER SUPERFICIAL TEMPERATURE.

Although up to the twelfth or thirteenth day the great mass of the egg has a somewhat lower temperature than 102 degrees, it is probable that it has a superficial temperature in the neighborhood of the germ of from 100 to 100½ degrees even at first. This assumption is based upon the fact, noted from a series of careful experiments, that if the eggs are maintained at a temperature rising from 98 to 100 degrees, the development at seven days is from twenty-four to thirty-six hours behind that of the same period under natural incubation. When the eggs are incubated at an initial temperature of 100½ degrees, gradually rising to 102 by the eleventh day, and maintained at that degree for the balance of incubation, the chicks are usually all excluded by the middle of the twenty-first day; that is, if the eggs are not subjected to too frequent and prolonged exposure to a cold atmosphere. In the latter case the eggs will need to be maintained at a higher temperature during the entire period. When the eggs are maintained at a temperature of 100½ to 102 degrees, and subjected to little or no exposure to a cold atmosphere, the embryonic development is found to correspond approximately to that under natural incubation.

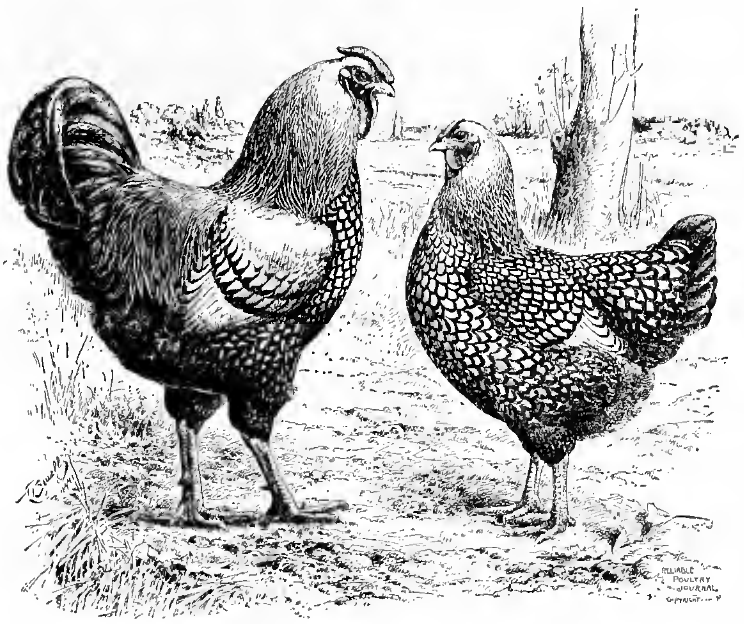


BUFF WYANDOTTES.

STANDARD WEIGHTS { Cock, 8½ pounds; Cockerel, 7½ pounds.
Hen, 6½ pounds; Pullet, 5½ pounds.

Characteristics—Cost of raising to maturity, $0.70. Annual cost of keeping, $0.80. Average egg yield per year, 175. Average number of eggs to pound, 9. Average constitution. They are good as foragers; can stand confinement; are fine as sitters and good as mothers. Grain and flavor of flesh good.

The reader will bear in mind that the temperature of the egg is spoken of, and not that registered by the thermometer.



SILVER LACED WYANDOTTES.

STANDARD WEIGHTS { Cock, 8½ pounds; Cockerel, 7½ pounds.
Hen, 6½ pounds; Pullet, 5½ pounds.

Characteristics—Cost of raising to maturity, $0.70. Annual cost of keeping, $0.80. Average egg yield per year, 175. Average number of eggs to pound, 9. Average constitution. They are good as foragers; can stand confinement; are fine as sitters and good as mothers. Grain and flavor of flesh good.

COOLING THE EGGS.

If an abundance of food and water is placed where it will be accessible to the hen when she leaves the nest, it will be found that, if left to herself, a successful sitter remains on the eggs two, three and even four days at a period without leaving them. In exposing eggs to the atmosphere two facts must be taken into consideration. When the hen returns to the nest the eggs quickly regain their normal temperature; while, when the eggs are removed from an incubating chamber under artificial incubation, they are some time warming up when replaced. It has been held that the eggs need to be cooled in order to absorb fresh oxygen, but this view arose through ignorance of the laws controlling the movement of gases, and is entirely fallacious. It is well, however, to cool the eggs when incubating during warm weather, or else run the temperature a trifle lower.

APPLICATION OF HEAT.

As was shown in an earlier part of this article, 100½ degrees at the initial stages, gradually rising to 102 degrees by the eleventh day, is probably the correct incubating temperature for hen eggs. We have now to consider how we are to maintain them at that temperature. The atmospheric conditions to be maintained during incubation will be discussed under the head of ventilation.

In artificial incubation an equable distribution of heat over a comparatively large surface is first to be desired. This is very difficult of attainment, the reasons for which are obvious.

In the first place, as a basis of discussion, let us take an incubating chamber say thirty-six inches square, twelve inches in height, with egg trays placed five inches from the bottom. Such a chamber will hold 360 duck or 400 chicken eggs. This is as large as it has been found practicable to make a hot-air machine, and about as small as it is economical to make one heated through the agency of hot water. We will say the heating body comprises the entire upper surface of the chamber.

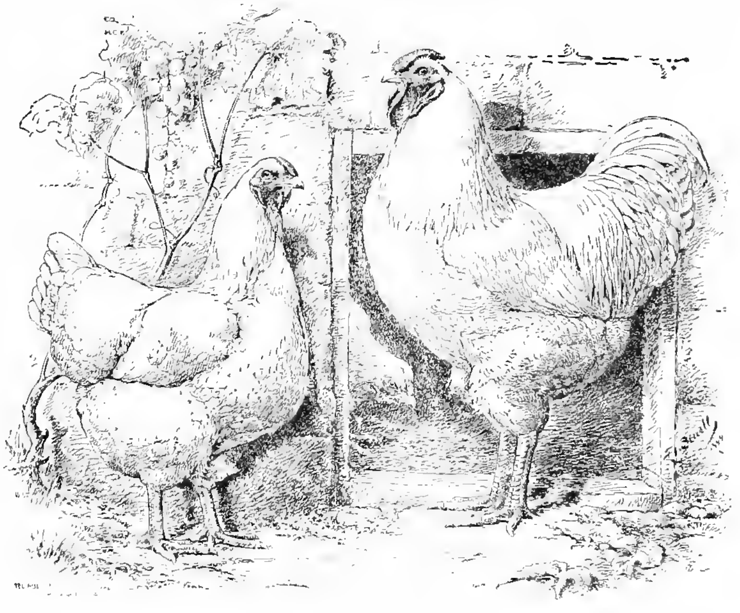
AN UNEQUAL TEMPERATURE.

We will now suppose the heating surface has been brought to a uniform temperature by some means, and all the direct heat rays given off of equal energy. If we now place several thermometers in the machine, and note their temperature, we will find those in the center registering the highest, those a little farther towards the sides a lesser temperature, and those nearest the sides the lowest. It is evident that the sides are giving off less radiant energy than they are absorbing, causing a loss of heat to the chamber. As it is quite impracticable to make a case that is a perfect nonconductor, we shall always have this feature to contend with. The loss of heat energy is felt to the greatest extent in that portion of the chamber near the sides, for the reason that radiant heat diminishes in intensity as the square of the distance from the radiating surface increases. The distance being the greatest at the center of the chamber from the surface where the loss of warmth occurs, that portion is the least affected.

EQUALIZING THE RADIANT ENERGY.

We will now consider the effect of equalizing the radiant heat within the chamber by creating inequalities of temperature in the heating body. This may be done for any particular temperature, by directing the flow of hot water or air over the heating body, but the same inequalities will not answer for all temperatures. For instance, we will say that the temperature of the air around the machine is 80 degrees, the highest atmospheric temperature in which any machine should be operated.

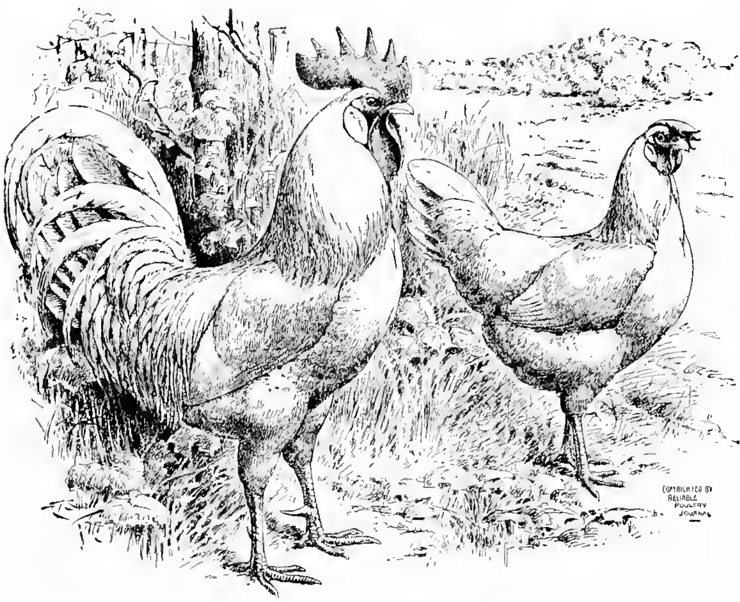
At this temperature the loss of warmth through the medium of the walls or casing of the chamber is at its minimum. We now direct the flow of hot fluid in such a manner that it warms the heating body near the walls of the chamber to a certain degree of temperature above that at the



WHITE WYANDOTTES.

STANDARD WEIGHTS { Cock, 8½ pounds; Cockerel, 7½ pounds.
Hen, 6½ pounds; Pullet, 5½ pounds.

Characteristics—Cost of raising to maturity, $0.70. Annual cost of keeping, $0.80 Average egg yield per year, 175. Average number of eggs to pound, 9. Average constitution. They are good as foragers; can stand confinement; are fine as sitters and good as mothers. Grain and flavor of flesh good.



SINGLE COMB WHITE LEGHORNS.

POPULAR WEIGHTS { Cock, 5 pounds / Hen, 4 pounds. } No Standard Weights.

Characteristics—Cost of raising to maturity, $0.40. Annual cost of keeping, $0.75. Average egg yield per year, 190. Average number of eggs to pound, 10. Hardy constitution. They are fine as foragers; can stand confinement; are nonsitters and poor as mothers. Grain and flavor of flesh poor.

center, the temperature of the intermediate points being graduated proportionately. If we have correctly estimated the difference in temperature required, we will now find that the greater radiant energy given off by the heating body near the walls of the chamber offsets exactly that which is absorbed, and thermometers now placed in different parts of the chamber will show that they are all receiving the same amount of radiant heat. We will now take this machine, the hatching chamber of which was equally heated when surrounded by an atmospheric temperature of 80 degrees, and place it under an atmospheric temperature of thirty-five degrees, about the lowest temperature in which any machine should be operated. The loss of warmth is now at its maximum, and we find that the greater warmth of the heating body near the walls of the chamber no longer offsets that absorbed. We shall therefore need to increase the inequality of temperature of the heating body under the new conditions. It is thus obvious that an incubating chamber cannot be constructed so that it will maintain the eggs at an equable temperature under all conditions, and that the best we can do is to construct the chamber so that it will have an equable temperature when placed in the mean of the atmospheric temperatures in which it is going to be operated. If this is done, and the walls are properly constructed, the greatest variation need not be more than a degree, or possibly a little less. The corners will show the greatest variation, for the reason that the surface of absorption (the wall area) is relatively larger at these points than the surface of the heating body.

To offset any differences in temperature, the relative position of the eggs should be reversed. This may be quickly done by simply turning the trays around so that the cool side takes the place occupied by the warmer. If this is done twice a day, say when the eggs are turned, a difference of a degree in temperature will do no harm. Even greater differences of temperature in the different parts of a machine may be offset, to a greater extent, by shifting the location of the different trays.

THE HEAT MUST BE REGULATED.

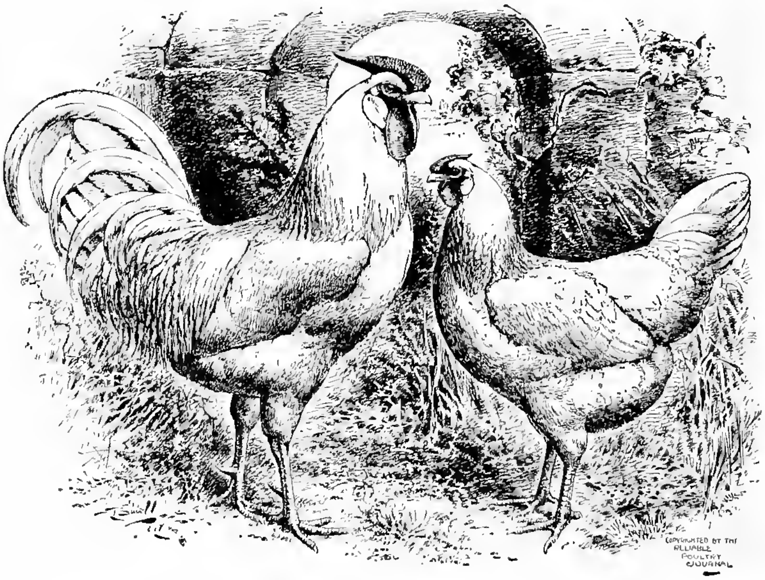
Let us suppose the hatching chamber to have an equable temperature, and the temperature of the heating body, as well as that of the outer atmosphere, to remain stationary throughout the entire period. From our present point of view all the eggs would thus be under perfect thermal conditions if they were at the proper temperature to start with. This is practically a theoretical condition, for in practice we will need to regulate the temperature of the heating body so that the heat given off by it will be just sufficient to offset that lost by the chamber when placed under various outer atmospheric temperatures. We can reduce the temperature of the air and eggs without reducing the temperature of the heating body by giving more ventilation, and thus replace the warmer air with that of a lesser temperature; but this method is not a desirable one, the reasons for which will be cited when considering the subject of ventilation.

Before considering the regulation of the temperature of the hatching chamber, however, we will need to know when its temperature is at the desired degree; or what is of more importance, and sometimes considerably harder to ascertain, what is the degree of temperature of the eggs.

A GOOD THERMOMETER.

To start with we shall need to secure a good thermometer. Many comparatively new glasses are still put out, and after the tube ages they register half a degree or more high. This will not make much difference if we know what the correction is. In scientific work requiring their use the thermometers are always tested from time to time, and the correction ascertained. After a thermometer is a year and a half or two years old, further aging will change it very little. A new glass will change the most during the first six months, at which time some manufacturers graduate and place them on the market.

There should always be a good standard thermometer on



ROSE COMB WHITE LEGHORNS.

POPULAR WEIGHTS { Cock, 5 pounds, / Hen, 4 pounds, } No Standard Weights.

Characteristics—Cost of raising to maturity, $0.40. Annual cost of keeping, $0.75. Average egg yield per year, 190. Average number of eggs to pound, 10. Hardy constitution. They are fine as foragers; can stand confinement, are nonsitters and poor as mothers. Grain and flavor of flesh poor.

every place, so when a new glass is bought, it will be easy to learn the correction, if any, and to test it from time to time afterwards. A good way to test a thermometer is to place it, together with one known to be correct, in a body of water which has been previously heated to 105 degrees. Allow the water to cool down gradually, and note the temperatures of the two as they fall through five degrees. The water will need to be continually stirred, for otherwise all kinds of temperatures can be detected in it, and we would not know when the two thermometers were receiving a like amount of heat.

THE TEMPERATURE OF THE EGG.

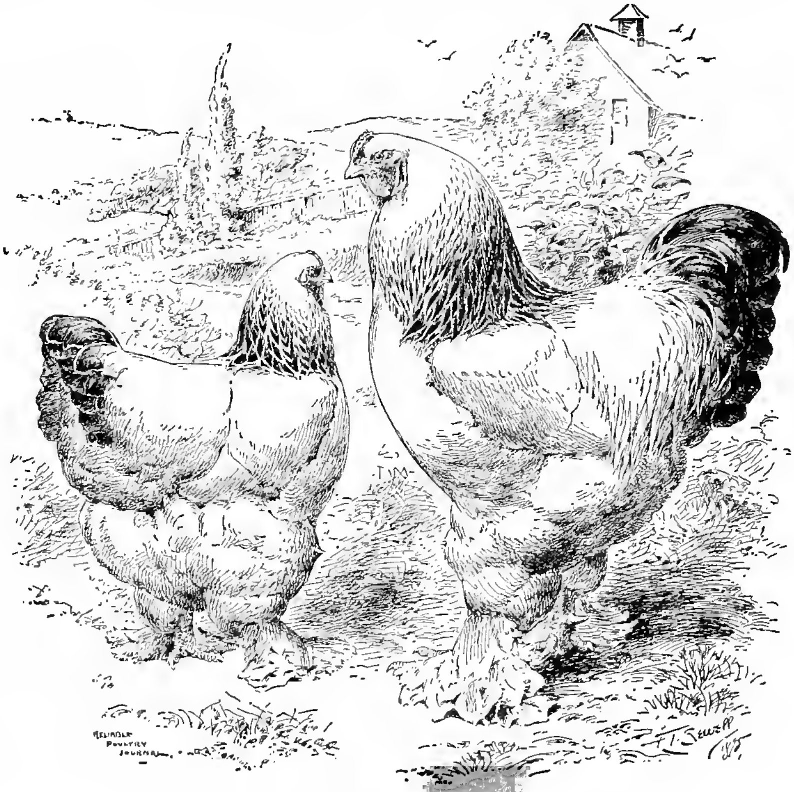
To ascertain the temperature of the egg without breaking it is impossible with the use of the thermometer. If we place a thermometer so that its bulb rests upon a fertile egg, it does not necessarily give us the temperature of all the eggs, or even the majority of them. Nevertheless, it is the best way to run a machine in which the eggs are warmed by radiated heat. In machines in which the eggs are heated by simple contact with warm air, a hanging thermometer, the bulb of which is suspended half an inch above the eggs, will give the general temperature of the chamber, which should in this case be run at 102½. This gives an egg a temperature of 100 degrees at the start, and 102½ to 103 at the finish, which gives the best average results.

The means to be employed to keep the chamber at a constant temperature must rest with the manufacturer. The regulator should be simple and effective. The application of heat and the regulation of temperature in artificial incubation should be made as uniform as it is possible to make it. There are atmospheric conditions that are of equal importance as an even temperature, and which are equally as hard to maintain, and if we allow one condition to vary here, and another there, we cannot expect to get the best results. In fact, unless there is an equal balance between the heat and atmospheric conditions, incubation cannot be carried to a successful exclusion.

There is a certain incubating temperature to be maintained for the best possible results to be produced, and certain mechanical and atmospheric conditions to be observed from the time the egg is laid until the exclusion of the chick. Simply because a puppy will live for fifty minutes under water, are we to leave him out in every shower; or, because the human body can exist under a temperature of 300 degrees in a dry air, do we wish to run the temperature of our living rooms up to that degree two or three times a day? The vicissitudes of temperature, climate, and other conditions under which living organisms will continue to exist, are extreme, in deed, and the limitations are usually proportioned to the changes the individual has normally to withstand; but in all organic life the highest development is only attained under particular, narrow, and usually well defined limits. The incubator, therefore, that has the best regulator for maintaining an equal temperature has a long advantage over its competitors in hatching strong, healthy chicks.

VENTILATION.

In natural incubation the eggs are placed in a respirable fluid which surrounds the earth and forms its atmosphere. This fluid, which is known as the atmospheric air, is composed by volume of twenty-one parts of oxygen and seventy-nine of nitrogen. Air also contains 1-2500 volumes of carbon dioxid, some aqueous vapor, and small, varying amounts of ammonia, nitric acid, ozone and organic matter. Its constituent gases are not chemically united, but are mixed mechanically. It may be spoken of as oxygen diluted with nitrogen, the oxygen being the active and the nitrogen the neutral body. When air is inhaled into the lungs the oxygen is separated from the nitrogen. It unites with the carbon in the blood and is expelled as carbonic acid gas, more properly called carbonic anhydrid or carbon dioxid, a gaseous compound of twelve parts by weight of carbon and thirty-two of oxygen. Diffusing inward through the shell, the air reaches the covering membrane of the egg, which, being thin and moist, offers no serious impediment to its passage inward, the transmission being effected with perfect ease. A partial separation, however, is effected, for, whereas atmospheric air consists of twenty-one volumes of oxygen and seventy-nine of nitrogen, air contained in the egg contains about thirty-three per cent of oxygen.



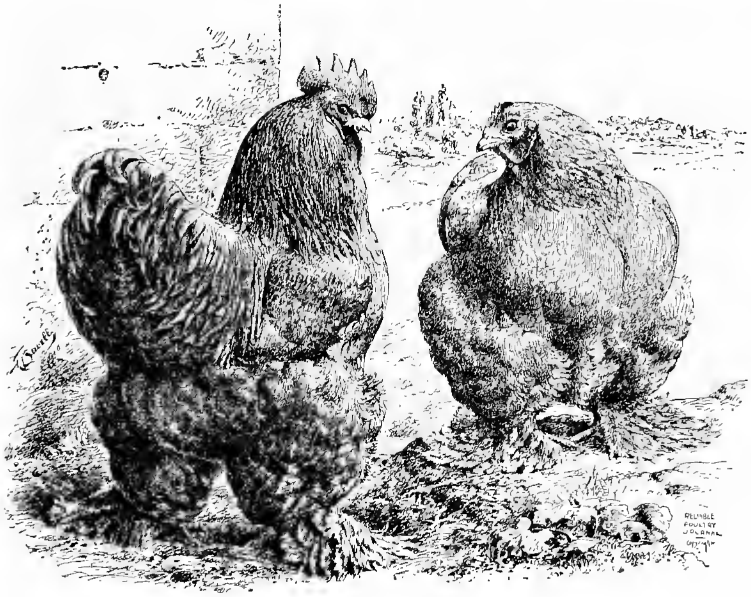
LIGHT BRAHMAS.

STANDARD WEIGHTS { Cock, 12 pounds; Cockerel, 10 pounds.
Hen, 9½ pounds; Pullet, 8 pounds.

Characteristics—Cost of raising to maturity, $0.90. Annual cost of keeping, $0.90. Average egg yield per year, 150. Average number of eggs to pound, 7. Hardy constitution. They are fair as foragers; can stand confinement; are heavy as sitters and clumsy as mothers. Grain and flavor of flesh fair.

If an egg be varnished over before incubation commences, and the air thus excluded, there will be sufficient oxygen already within the shell to suffice for the development of the blastoderm (that portion of the ovum from which the organs of the embryo are formed), up to about the fifteenth hour of incubation, and the life of the germ is not destroyed until between the twenty-fourth and thirtieth hour, but a fresh supply of oxygen is essential to further development. That is, in order that the nutritious yolk may be afforded to the nutrition of the embryo, it is necessary that it should undergo some changes in which the atmospheric air is concerned, as in the germination of seeds, and during the development of the embryo its blood requires aeration as much as that of the adult animal. In nearly the whole stage of development there is a general or interstitial (pertaining to an interstice or narrow space between parts of the embryo) respiration, or a change essential to life, produced by oxygen in all the substances of the embryo and of its accessory parts, which, as the embryo is more perfectly formed, takes place more actively in particular organs only. As soon as a peculiar nutritive fluid and a central propelling organ are produced, this fluid is exposed on the expanded surface of the yolk to the influence of the oxygen absorbed in the albumen. This blastodermic expansion, or vascular area, throws out villi (hair-like processes found on certain membranes) from its under surface to absorb the yolk, which, in a partially assimilated condition, is transferred to the blood-vessels that ramify over its surface. Thus it acts as the organ of circulation, respiration, and nutrition.

As the vascular area rapidly spreads over the yolk, it continues to act as the chief organ of absorption and digestion, but its importance as a respiratory organ gradually diminishes. In its stead a special respiratory and excretory organ (an organ for getting rid of waste matter) is developed in the allantois. The allantois also serves a nutritive function, for by it the denser portion of albumen is ultimately enclosed and absorbed. It is very vascular, and until the last few hours serves as the chief organ of respiration, the oxygen gaining access to it through the coverings of the egg, with which it is in contact.



BUFF COCHINS.

Standard Weights { Cock, 11 pounds; Cockerel, 9 pounds.
Hen, 8½ pounds; Pullet. 7 pounds.

Characteristics—Cost of raising to maturity, $0.85. Annual cost of keeping, $0.90. Annual egg yield per year, 140. Average number of eggs to pound, 8 Average constitution. They are poor as foragers; can stand confinement; are fair as sitters and mothers. Grain and flavor of flesh poor.

The passage of carbon dioxid and hot watery vapor out of the blood, and of oxygen into it, is the essence of the respiratory process and thus a membrane with blood on one side, and oxygen on the other, is all that is absolutely necessary to effect the purification of the blood. Blood holds in solution rather less than half its volume of gases, two-thirds of which is carbon dioxid, less than one-third oxygen, and not one-tenth nitrogen. It contains rather more oxygen gas than could be held in solution by water, not in a free state, but held in some sort of loose chemical combination with a constituent of the blood. The functions of the blood are to supply nourishment to, and take away waste matter from all parts of the body. It is absolutely essential to the life of every part of the body that it should be in such relation with a current of blood that matters can pass freely from the blood to it, and from it to the blood, by diffusing through the walls of the vessels in which the blood is contained.

VENTILATION A VITAL NECESSITY.

Carbon dioxid is constantly generated in the body, and is, therefore, to a certain extent, one of the natural constituents of the blood; but, when not promptly thrown off, its action becomes quickly injurious. When an egg is covered with an impermeable varnish, or the mutual diffusion of the gases on either side of the shell is in any way sufficiently prevented, what is called asphyxia takes place, and the embryo soon dies. This is caused by lack of oxygen and excess of carbon dioxid in the blood. It is not necessary to close the pores of the shell to bring on asphyxia, but this condition can be effected either wholly or in part by decreasing the proportion of oxygen, or increasing that of the carbon dioxid in the surrounding medium.

The proportion of carbon dioxid naturally existing in the atmosphere may be assumed as inoffensive, but all increase is more or less deleterious. A cubic foot of air of average purity contains a little less than a cubic inch of carbon dioxid. When this amount is increased to eight or ten per cent, the vital activity is sluggish, and when raised to twelve or fifteen per cent it is speedily destructive to the life of the germ. The cause of this is obvious. Other things being alike, the rapidity of diffusion between two gaseous mixtures depends on the difference of the proportions in which their constituents are mixed; it therefore follows that the more nearly the proportion of carbon dioxid on the one side of the membrane approaches that on the other, the slower will be the diffusion of carbon dioxid outward, and of oxygen inward, and the more charged with carbon dioxid and defective in oxygen will the contents of the egg become. And, on increasing the proportion of carbon dioxid in the outer air, a point will at length be reached when the change effected is too slight to relieve the respiratory blood of its carbon dioxid, and to supply it with oxygen to the extent required for its aeration.

Thus we can appreciate the vital necessity of ventilation, or the purification of the air surrounding the egg, which is essentially the dissipation of the carbon dioxid exhaled, and the replenishing of the oxygen consumed. The purification of the general atmosphere is maintained by various agencies of nature. By the law of diffusion all gases intermingle, so that where impurities are set free at any point they tend to diffuse away, and thus become weakened or lost in the great body of the atmosphere. The mixture of large masses of air and the dispersion and dilution of local impurities are also affected by the winds. Gaseous exhalations are washed out and absorbed from the atmosphere by the fall of rains. The earth's vegetation absorbs and consumes carbon dioxid, while the oxygen is set free. The oxygen of the air slowly burns up the numberless combustible vapors and contaminations which are thrown into it. By these means the earth's atmosphere is constantly maintained respirable and pure.

A CURRENT OF AIR UNDESIRABLE.

As has been shown, in natural incubation a spontaneous intermixture or diffusion of the gases takes place through the coverings of down and feathers, though they are sufficiently dense that any current in an outward and inward direction is prevented by frictional resistance. The latter aids in keeping in the warmth, and also in the rotting of the shell. That is, the carbonate of lime, of which the shell is composed, absorbs moisture. Carbonate of lime, however, is altogether insoluble in pure water, while water saturated with carbon dioxid dissolves 1-1500 part. Water, under ordinary circumstances, absorbs rather more than an equal volume of carbon dioxid. For its own temperature, the exhaled carbon dioxid is saturated with aqueous vapor; a part of both being condensed by the shell. Thus the ovum itself furnishes the means for the disintegration of the particles of the shell—the carbon dioxid rendering the carbonate of lime soluble in the water or moisture, which is always present. Although a free exposure of the egg to the atmosphere is indispensable to the development of the embryo, yet a current of air is exceedingly undesirable, as the rapid circulation of the atmosphere would be attended with the quick dissipation of the moisture and carbon dioxid.

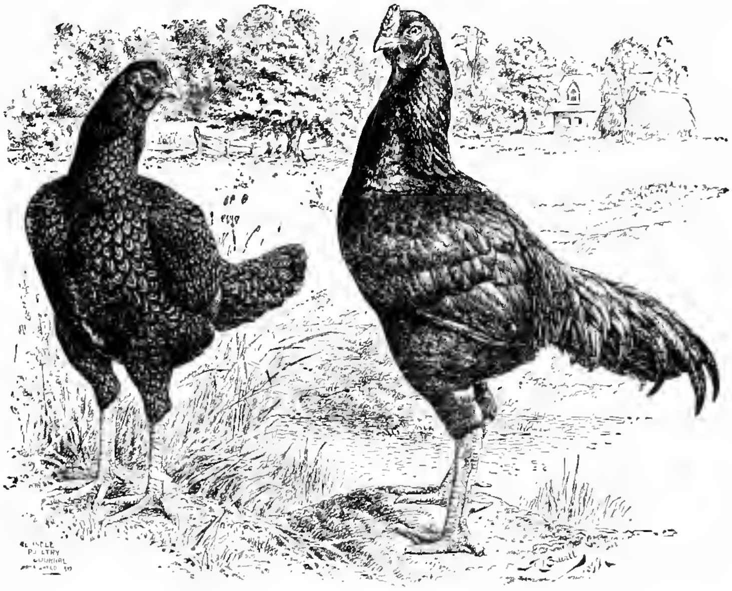
THE RELATIVE HUMIDITY.

The rapid movement of the air around the eggs has yet other and equally deleterious effects, but they all, however, involve the same principle, i. e., the drier air, and the more it is agitated so as to bring fresh currents in contact with the moist surface, the more rapidly does evaporation take place. The effect of warmth is also to hasten evaporation, but a high degree of heat is not essential to it. At ordinary temperatures, wherever a moist surface is in contact with the air, vapor is formed. This process is called spontaneous evaporation. Aqueous vapor is always present as a minor constituent of the atmosphere, and its amount, which is very variable both at different places on the earth's surface and in the same locality at different times, forms an important element of climate. The process of evaporation is constantly going on at the surface of the earth, but principally at the surface of the sea and other bodies of water.

The amount of vapor which can exist in the air is limited, and depends upon its temperature. It is therefore evident that if the air be saturated with moisture, no more can be vaporized; and that, in proportion as it approaches saturation, must the process of evaporation be retarded. Whereas, if the air contains but little vapor it can readily take up a large additional amount, and the process of evaporation must be proportionately hastened. On dry, cold days in winter, the evaporation is exceedingly rapid; whereas, if the air contains much moisture, it proceeds very slowly, even though the air be warm. In other words, space has a capacity for vapor depending upon its temperature, so that if there is a given definite amount or weight of vapor in the air at a certain temperature, the relation which this vapor bears to the whole vapor-carrying capacity of the air at that temperature is very different from the relation which the same amount of vapor bears to the carrying capacity of the air at another temperature. This relation is commonly called the relative humidity. Air of a given temperature becomes saturated when there is a certain amount of vapor present, and it can be made to take up no more unless its temperature be raised. Any surplus vapor must be condensed. This vapor present in the atmosphere has as a gas a certain pressure, tension or force, whichever term we care to use to express the same thing; and this tension may be as great or greater at the freezing point of water than during ordinary summer temperatures, as the atmospheric air is seldom completely saturated when its temperature is high.

All air formed in a natural condition contains more or less of this gas which we call vapor, though it is seldom in a state of complete saturation. Even the dry air blowing over a heated desert contains a small amount and it is this amount which largely influences the rapidity of evaporation.

In natural incubation the eggs are surrounded by a mass of warm air, held entangled and separated from the outside atmosphere by a porous septum (partition) of down and feathers, which allows of a reciprocity movement, or free interchange of the constituent gases and vapors of the inner and outer atmosphere. In other words, the air immediately in contact with the incubating body and eggs becomes warmed. In the gain of heat it expands, becomes lighter, or of a lesser specific gravity than the outside colder and denser air, and tends to flow outward into the latter, which replaces it. It does not, however, carry all its increased warmth with it. That is, in passing outwards, its molecules come in contact with those of the incoming colder air, and imparts to them a portion of its own greater warmth. This loss of heat by the outgoing, and gain by the incoming air, does not quite equalize their warmth within the walls of the septum, under ordinary conditions, but the incoming air gradually gains heat until it comes into direct contact with the heating body, when it has reached its maximum temperature, and then, flowing outwards, loses heat until its remaining warmth is finally dissipated in the surrounding atmosphere. Thus it is seen that the loss of heat is reduced to the minimum, notwithstanding the fact that the atmospheric air surrounding the eggs is being continually changed. The carbon dioxid and organic matter thrown off by the incubating body, and eggs also, as it gains in tension, gradually diffuses outward, being replaced by pure respirable air.



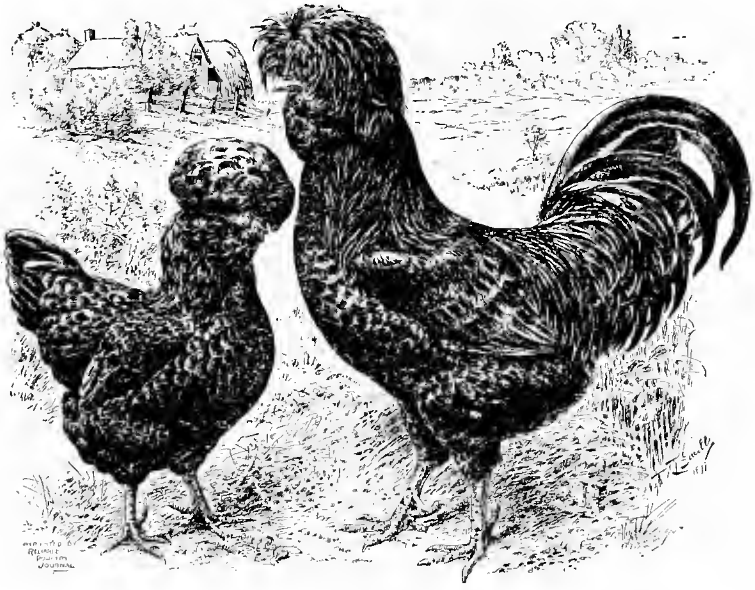
CORNISH INDIAN GAMES.

STANDARD WEIGHTS } Cock, 9 pounds; Cockerel, 7½ pounds; Hen, 6½ pounds; Pullet, 5½ pounds.

Characteristics—Cost of raising to maturity, $0.75. Annual cost of keeping, $0.90. Average egg yield per year, 130. Average number of eggs to pound, 9. Tender constitution. They are fair foragers; can stand confinement; are fair as sitters, and make good mothers. Grain and flavor of flesh above the average.

Again, as it has been shown that the porous septum offers no serious obstruction to the interchange of gases and vapors, it will be seen that the relative humidity or tension of the aqueous vapor in the two atmospheres must be essentially the same, regardless of the differences in temperatures. That is, the quantity of aqueous vapor held in suspension by the outside colder air is as great for its own temperature as the quantity held in suspension by the inner warmer air, and therefore the tension of the aqueous vapor is as great in one atmosphere as in the other. Either an increase or loss in one is immediately felt by the other, and a corresponding movement from the greater to the lesser immediately sets in, and tends to restore their equilibrium. Aqueous vapor will diffuse neither outwards nor inwards when it exists in the same proportion in both atmospheres, but dry carbon dioxid only will be exchanged for dry air, in the proportion of their equivalent diffusion volumes. The incubating body and eggs, however, are continually throwing off watery vapor, which, increasing the tension of the vapor in the inner air above the tension of the vapor in the outer atmosphere, causes a slow diffusion outward, the movement tending to keep up the equilibrium.

Thus the relative humidity of the two atmospheres is always essentially the same whether the hen nests in a meadow on moist ground, and surrounded by a moist atmosphere, or in a hay-loft and surrounded by a dry air. And as she brings out equally as large a proportion of chicks in one place as the other, it is obvious that ordinary changes in the degree of humidity of the atmospheric air has no serious ill effect on the incubation of an egg.



HOUDANS.

STANDARD WEIGHTS { Cock, 7 pounds; Cockerel, 6 pounds.
Hen, 6 pounds; Pullet, 5 pounds.

Characteristics—Cost of raising to maturity, $0.70. Annual cost of keeping, $0.90. Average egg yield per year, 170. Average number of eggs to pound, 9. Average constitution. They are good as foragers; can stand confinement; are fair as sitters and poor as mothers. Grain and flavor of flesh good.

UNDER ARTIFICIAL CONDITIONS.

We have seen that in natural incubation there is a reciprocatory movement, or free interchange of the constituent gases or vapors of the inner and outer atmosphere, through the intervening septum of down and feathers, which keeps the inner air respirably pure, and tends to maintain the relative humidity of the two atmospheres. On the other hand, in artificial incubation the colder outer air, passing inwards en masse through one or more wide apertures in the solid wall of the egg chamber, creates a current sufficient to carry along with it whatever vapors with which it may be charged. Mingling with the inner warmer atmosphere, and coming in contact with the heating surfaces, it gains in temperature, which directly increases its capacity for taking up moisture. Reaching its maximum temperature, it eventually passes outward, still en masse, through the apertures, which again creates a current sufficent to carry along with it its vapors, with any additional gases or vapors it may have gained during its stay in the incubating chamber, and is dissipated in the surrounding atmosphere. This process is continuous, and is kept up as long as the apertures remain open, and the exchange between the two atmospheres is affected in the same manner; that is, by a continuous inward and outward current, whether there is but one or a number of apertures, the only difference being in degree or rapidity of the change, depending upon the area and location of the opening and the temperature of the surrounding atmosphere. In some machines the activity of exchange between the two atmospheres has been reduced to the lowest point, but with a corresponding loss in the purity of the air within the egg chamber.

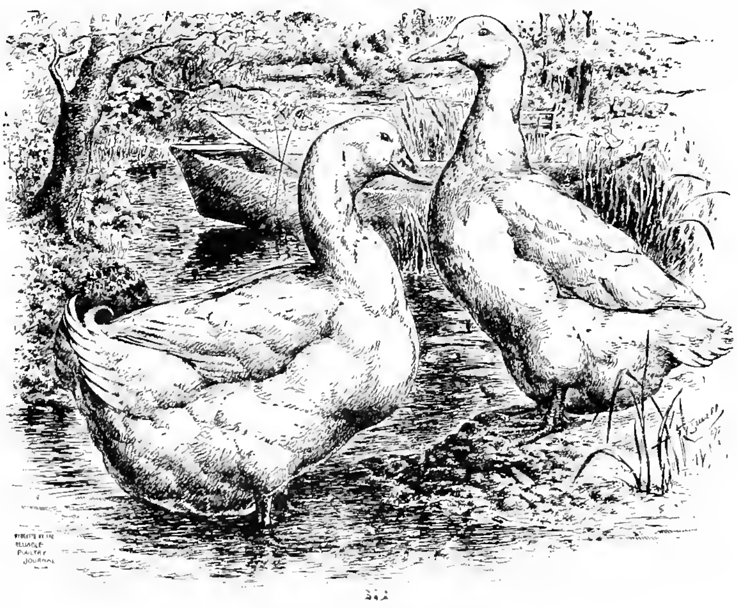
The immediate effect of ventilating the chamber in which the eggs are placed by means of more or less wide openings ln its walls, is to increase the capacity of the incoming air to take up moisture by raising its temperature, without providing to any appreciable extent for the absorption of moisture from the exterior atmosphere, and also the dispersion or carrying away of any moisture gained from the eggs placed within the chamber. Thus it is seen that the air around the eggs is in a comparatively dry state, there being a wide difference between its degree of humidity and its total capacity for moisture at its temperature. This state of the air stimulates vaporization, and causes an excessive evaporation of the watery portion of the egg. The egg originally contains about 74 per cent water, but nearly all of this large amount is as essential to the development of the embryo as the solids, for water is a very large constituent of all parts of the body. The bones contain 130 parts of it in 1,000; the muscle, 750; the blood, 795; and it forms in fact nearly three-fourths of its entire weight. It is evident, therefore, that if the supply of water is diminished by excessive transudation (passage through the shell) and evaporation, the development of the embryo cannot go on.

The rest or movement of the air is of more importance than the difference in the tension or degree of humidity, as influencing the rate of evaporation; for it is found that evaporation is much slower in still air than in a current, with the same degree of humidity. The air immediately in contact with the moist surface becomes saturated with vapor, and a check is soon put to evaporation; if, however, the air be quickly removed as fast as it becomes charged with vapor, and its place supplied with fresh, dry air, the evaporation continues with undiminished rapidity. It is the protection from any current of air that largely prevents a rapid evaporation from the eggs in natural incubation, the diffusion of air and vapor around the eggs being a slow process of exchange in comparison with a current of air.

As incubation progresses there is a special respiratory organ developed, called the allantois, which eventually encloses the whole contents of the egg, and the exhalation of moisture then becomes a vital process. Yet the rest or movement of the air influences the amount of evaporation, even after it ceases to be merely a physical process; for we find that when a frog is placed in the draft of an open window it will lose triple, or even quadruple the amount exhaled by others placed at a closed window in the same room. It is during the last stages of incubation, and after the exhalation of moisture becomes a vital process, that the rapid evaporation from the surface of the egg, excited by a current of dry air, does the most harm, and which many times ends in the death of the embryo. The cause of the fatal effect of the rapid evaporation is to be found in the drying of the enclosing membranes of the egg; or, in other words, the membrane covering the ovum becomes too dry to take up enough oxygen to suffice for the development and vital activity of the embryo. While moist animal membranes allow the exchange of carbon dioxid and oxygen to be effected with perfect ease, offering no serious impediment to the passage of either gas, dry animal membranes are impermeable to gases.

Although the drying of the covering membranes often cuts short the development of the embryo, and the germs die at various stages of incubation, more generally the embryo suffers the most from this cause from the seventeenth day to exclusion, the greatest number dying about the eighteenth or nineteenth day. By the seventeenth day the albumen is about all absorbed, and the yolk is decreasing in size, and is less fluid. The chick is breathing by means of the allantois which entirely surrounds it and which is in close proximity to the shell and surrounding atmosphere. As the amniotic water (a fluid contained in the amnion which is the membranous sac that envelops the embryo) in which the embryo has been immersed is reabsorbed, the sac in which it was contained fills with air, and the chick drawing this air into the lungs, the pulmonary respiration is gradually established. As the pulmonary circulation increases in activity, the circulation of the blood in the allantois gradually diminishes, and the allantoic fluid eventually disappears, so that by the end of the nineteenth day the only moisture of any consequence left within the egg is that contained in the substance of the yolk and embryonic structure. There is a pretty timing, however, in the loss of fluid by the allantois, for it does not normally entirely disappear until within a few hours of the rupture of its coverings by the chick, the membranes remaining moist for some time after, and do not become dry until the chick has been breathing the surrounding air direct for several hours. This is the critical period, for if evaporation be too rapid the allantoic fluid is too early dissipated, and the allantois then is dependent upon the embryo for its supply of moisture necessary to its function as a respiratory organ, and, should the rapid evaporation continue, its membranes very soon become too dry to take up enough oxygen to suffice for the needs of the organism, and death supervenes.

On the other hand, while unduly hastening the drying of the allantois by excessive evaporation is fatal to the life of the chick, an excess of moisture present in the surrounding atmosphere is equally deleterious, although in the opposite direction; that is, in the prolongation of its functional activity. In other words, by the time the embryo is sufficiently ripe to rupture its coverings the circulation of blood in the allantois is normally quite sluggish, and as soon as the chick gains access to the surrounding air the allantoic circulation ceases, and its membranes become dry. But, should the air be overcharged with moisture, the allantois and blood gain fluid by absorption, and the allantois remains functionally active. Continuing to absorb moisture, the chick eventually gains an excess of water sufficient to interfere with its vital functions.



IMPERIAL PEKIN DUCKS.

STANDARD WEIGHTS { Adult Drake, 8 pounds; Young Drake, 7 pounds.
Adult Duck, 7 pounds; Young Duck, 6 pounds.

Characteristics—Cost of raising to maturity, $1. Annual cost of keeping, $1. Average egg yield per year, 120. Average number of eggs to pound, 5½. Hardy constitution. They are fair as foragers; can stand confinement; are good as sitters and mothers. Grain and flavor of flesh good.

FOUR PHYSICAL FORCES.

It will now be seen that, other conditions being equal, the degree of humidity ordinarily existing in the atmospheric air is sufficient for successful incubation, providing that the tension of the moisture in the two atmospheres remains the same, and that the rate of movement of the air surrounding the eggs exercises a more powerful influence on evaporation than the usual variations of humidity. In the construction of a hatching chamber, therefore, there are four features of vital importance to be considered, viz., a non-conducting wall that will protect the eggs from outward changes of temperature; a provision for maintaining the atmospheric air within the chamber in a pure state; the maintenance of as great a tension of aqueous vapor in the inner as in the outer atmosphere for their respective temperatures, and the control of the movement of the air around the eggs.

As we have before stated, in natural incubation the purity of the air surrounding the eggs is maintained by exchanges with the outer atmosphere through the wall or septum that intervenes. This wall is composed of down and feathers, which allow of a spontaneous diffusion of gases or vapors through them, while they are sufficiently dense to hold any current in check by frictional resistance. It is therefore obvious that the natural provision for maintaining the purity of the air around the eggs also provides, through the same medium, for the retention of warmth, for an equilibrium between the relative humidity of the two atmospheres, and for the control of the movement of the inner air.

Appreciating these facts, it becomes easy to construct a machine that will control the physical forces of incubation, that is, the storage of warmth, and the purity, humidity and movement of the air surrounding the eggs. Having these forces under control by natural processes, and a regulator of temperature that will automatically control it to within one degree, or less, we are in a position to hatch as strong and well-developed chicks as can be excluded by the hen incubating. The chick coming into life in a well-ripened condition has a good chance to make a live of it.

TAKING OFF A HATCH.

In cold weather it is seldom necessary to open the machine before the chicks are well dried off. In warm weather, with a large hatch coming off, it is well to open up when the hatch is about two-thirds over and remove as quickly as possible those of the dry ones that can be reached handily without removing the trays. Keeping two or three hundred chicks in a small space for a long time does them no good, still they should not be removed too soon, or it will injure the balance of the hatch. It is always well to err on the side of lateness rather than haste. In moving the chicks from the incubator to the brooder during cold weather, use a warmly lined basket or box, as the chicks are at this time very easily chilled. A chill means bowel trouble, and bowel trouble in very young chicks means short life.

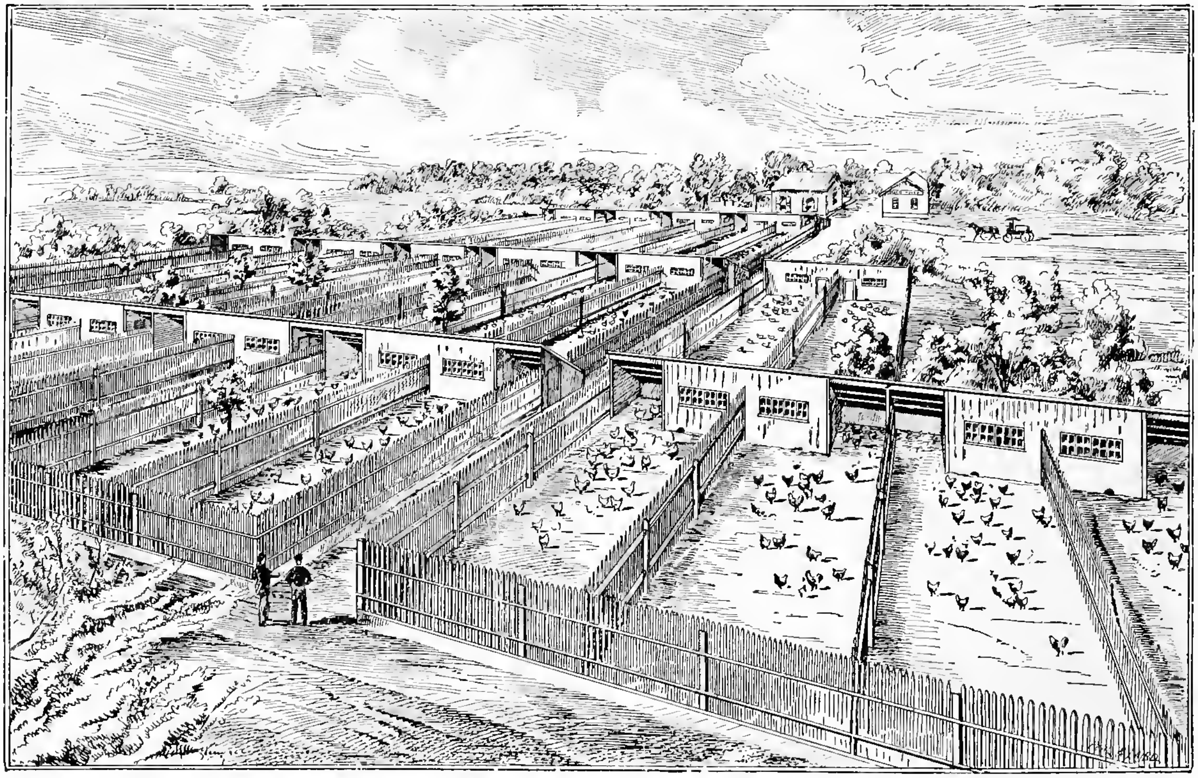
THE BROODER AND ITS USE.

If we have properly selected, housed and fed our laying stock, and hatched the eggs in a machine correctly designed, we now have as fine a lot of chicks as one would wish to see —strong and active. It is the active chicks that make a live of it. If you have been so unfortunate as to have bought your eggs of general farm stock, and have a mixed lot of culls, you will do well when dividing the lot for different brooders to put the strong and active in one brooder, and the weak together in another. Otherwise the latter will be crowded and trampled out of existence. Another way to prevent this is to put only fifty in a brooder.

It is safe to say that more failures in the broiler business have been caused by using market eggs—eggs purchased from farmers who kept a lot of inbred, all grain-fed culls—than from any other one cause. The chicks hatch weak, and what are left at six weeks old are fit for a show—all shapes, colors and sizes—and when marketed only bring third rate prices. So if you wish to secure chicks that are easily raised, and broilers that will command a premium over the top market quotations, look to your breeding stock before beginning to incubate.

The brooder temperature should be kept at ninety degrees for the first twenty-four hours, and then reduced one degree a day, regularly, for three weeks. If this is done the chicks will not feather so rapidly, and will be much stronger and more uniform than if kept at a high temperature, and the mortality will be less. At three weeks they will be ready to go into cold brooders, if the house is kept at seventy degrees, as it should be. This is the most successful plan for raising chickens. Use indoor brooders for the first three weeks, placing them in a building that can be kept at a temperature of seventy degrees. After the chicks are twenty-one days old they can be moved into rough board boxes or roomy hovers, the warmth of the brooder-house (seventy degrees) being ample for further needs.

The key to success in broiler raising is in never letting the young chicks get chilled, and in gradually hardening them off. The brooder-house should be well ventilated, and there should be no hover used in the small brooder. If the heat is kept where it should be, most any rational food will raise them. A food that is probably giving the best universal success is cracked wheat until they are three or four weeks of age. They will then be ready for forcing, and will stand concentrated foods, the composition of which can be regulated by the price of waste mill products and grain in each section.



The Plan of Scratching Shed Houses Adopted by Reliable Incubator Company, Quincy, Ill.

LAYING HOUSE WITH SCRATCHING SHED.

Claimed by Experts to be the Best Style of House Known to Poultrymen—Full Description, with the Bill and the Cost of the Materials.

BY A. F. HUNTER,
For Ten Years, Editor Farm-Poultry, Boston.

WE give herewith a drawing of our scratching shed plan of poultry house, with details of construction, and a photographic view of a house of this kind in use on the writer's poultry farm. A house on this plan can be built of any length desired, the pens and sheds being in groups of two, with doors opening through from pen to pen and from shed to shed, so that the whole house can be passed through without going out of doors. Each roosting room is 8x10 feet, and each shed (adjoining) is 10x10 feet, the front being 7 feet high, the back 4 feet high. We advise these heights because a 6 foot high front makes doors rather too low for a tall (or tallish) man, and head bumps should be avoided if possible.

Some one will ask, "Why not the walk at the back?" There are several reasons why we prefer the greatest height in front. First, economy. The walk at the back adds three feet to the width of the house, and increases the height at back by two feet, increasing the cost about a fourth (twenty-five per cent), and we don't think the corresponding advantages balance the disadvantages and added cost. Having the walk at the back, we must have six feet of height there, adding not a little to the cold temperature in winter. We must also have a door at the end of each pair of roosting pens, or else a solid partition (and door) between walk and scratching pen. True, we could have the double pitch roof, or the long and short pitch roof, with the apex over partition between walk and pens, but to get the desired seven feet height of front we would have to boost the roof up into the air two feet, making the house much colder. We very much want that seven feet height of front; then, in the winter, when the sun doesn't climb high, the whole floor of the scratching shed is bathed in sunshine. The shed having a tight roof, and being tight on the north and west, is all open to the south (when the curtains are up), giving the birds fresh air and sunshine, at the same time that they are protected from our cold northwest winds.

By this plan of house, too, the roost and roost platform are at the back, cut off from winds and drafts, and at the same time the roof is but about two feet above it. A curtain can be hung above front edge of roost platform, extending almost down to it, and this, let down on cold nights, encloses the birds on the roosts, keeping them snug and warm. We would have the north wall of this roosting pen double boarded so as to have a dead air space; the inner boarding being of matched boards, the outer of cheapest rough boards covered with two thicknesses of Neponset paper; red Neponset roofing outside, and sheathing paper underneath that, next the boards.

This shed and pen plan of house will give the best results for dollars expended. Each combined pen and shed is 18x10 feet, and will well house twenty-five fowls; and as it is the most economical plan to build upon, it is easy to see that it is by all odds the best for the man who has to make his dollars go as far as possible. For these reasons we recommend this compact open shed and roosting pen plan of house as being the best all-round house that can be built. We have one hundred and eight feet (in length) of this house on our farm, and find it just about perfect.

CONSTRUCTION.

We intend that the top of the sills of our house shall be about a foot above the ground level (we fill inside to bottom of sills, and slope up the ground outside to nearly same height). The sills are 2x4 scantling, halved and nailed together at splices and corners. The sills rest upon posts of cedar or chestnut, which go into the ground about two feet; if it is a three foot length of post it will go into the ground two feet two inches, and extend above the ground ten inches. There should be one at each corner of pens and sheds, and also one between each of these—giving a post to each five feet of front of sheds, and each four feet of front of pens. It will strengthen the building not a little to have one in the center of each cross partition, also, although that is not vitally necessary. Instead of posts we sometimes use pieces of scantling about eighteen inches long, reaching to stones set down in the ground to about the right depth. In that case the stone is the foundation, and the piece of scantling is a "stilt" to support sill. A board a foot in width is nailed along lower half of sill, extending into the ground three or four inches; the ground is "channeled" to receive it. This board laps one inch onto the sill (leaving the other inch of sill to nail upper boarding to); it is also nailed securely to foundation posts, or stilts. In a country where small stones are plenty, a stone wall foundation, ten inches high, will be easy to build, and will be cheap.

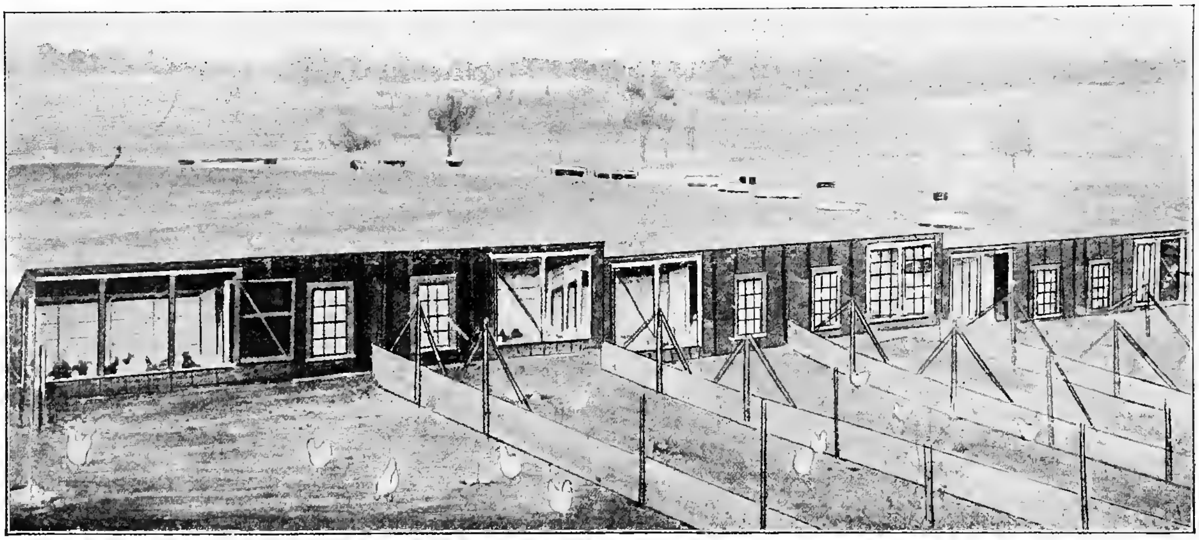
The plates are 2x4 scantling, same as sills, and are halved and nailed together at splices and corners. A sufficient number of studs six feet eight inches long for the front, and three feet eight inches long for the back, are cut from the 2x4 scantlings, one for each corner of the pen and shed. These are toe-nailed into sills, and the plates spiked onto top of them. We set an intermediate stud in front of each scratching shed, preferably of 2x4 stuff (though 2x3 will do), and two 2x3 studs in front of roosting pen set the right distance apart to receive the window intended to be used. At the back we use one intermediate stud of 2x4 stuff in each pen and shed. As we purpose double boarding this back wall, boarding on the inside of studs with matched boards, we use the 2x4 studs, and thus get the four inch dead air space; a 2x3 intermediate stud would give a three inch air space only, but would bring inner boarding flush with outer edge of corner studs, if one preferred that finish, a strip of furring being nailed onto side of corner studs to nail ceiling boards to.

Rafters are of 2x4 scantling, notched and spiked onto plates, the top end cut flush with outside of plate, the lower end projecting about eight inches, and mitered to nail a gutter to. It is best economy to set rafters two feet apart, as boards come ten, twelve, fourteen or sixteen feet long, and having rafters two feet apart saves cutting boards to waste, also makes a stiff roof. All outside boarding is lengthwise of buildings, and is cheapest hemlock boards, put on with as slight cracks as possible, then covered with, first, black Neponset sheathing; then, second, Neponset red rope roofing. This is put on lengthwise of building; also, each strip lapping about three inches, and secured with the tin head nails provided with each roll. The tin head nails should not be over three inches apart, and about a fourth inch above the edge (back from the edge) of top lap. We add battens, stripped one-half inch thick from seven-eighths inch boards, putting them on over the rafters, two feet apart. We give the roofing paper a coat of paint, and also paint the battens before putting them on, then put on a second coat of paint over battens and all.

A twelve-light window of 8x10 glass is set in the middle of front of roosting room, and a half window (six lights, 8x10 glass) is set in each partition between shed and pen. This, however, may be omitted if one prefers. The whole window, in the front, is better for being set in a window frame, so the lower half can be raised in hot weather. All our windows are protected by having wire netting tacked to frame on the inside; this is as much to prevent the fowls flying against and breaking the glass as to keep cats, etc., out when window is open.

The partition between two scratching sheds are boards up to a height of two feet, then wire netting, the two feet wide door being of light (furring) frame and same material, two 2x3 studs, one to shut door against and the other about half way between door and back. The same studding supports the partition between sheds and roosting rooms, one stud supporting the door, the other being set to support the half-window. The partitions between roosting pens have two studs, one to shut door against and the other half way to back; this partition is boarded up to bottom of rear plate and then wire netting above, for ventilation. In warm weather the doors to open sheds are left open, being fastened back by small hooks and screw-eyes; these, with the open slide doors (through which the chickens pass from the pens to the sheds), and open windows, give excellent ventilation. The ventilators in top of doors between sheds and pens can be left open in cool (not cold) weather, and the slide doors to sheds being left open in cool weather, give additional ventilation. The ventilators in top of the doors are simply part of the top of the door cut so it may be opened when the door is closed.

The roost platform is three feet wide, as long as will go easily in between the partitions, and rests upon strips of furring securely nailed to the partitions, the top of roost being twenty inches above floor. The platform we make of matched boards, and edge it with a strip of furring all around, so that it is a shallow pan one and a half inches deep. The two roosts are of 2x3 scantlings slightly rounded on top, and are fifteen inches apart, the rear one being ten inches from the back wall. These are secured to two strips of furring, which are hinged to the wall at the back six inches above the platform, and two six inch long legs at the front end of these cross pieces are the front supports. Hinged at the back the roosts can be tipped up out of the way when one wants to clean (or remove) the platform, a hook and screw-eye securing it up against the roof. We cut the roosts six inches shorter than the roost platform, so they come three inches within it at each end. The nest boxes are set under the roost platforms so the fowls can go round the ends and enter any apartment from the back, the front (hinged at top and secured by a simple button at the bottom) lifting up to allow the removal of the eggs. Keeping this front closed makes the nests dark and secluded, the most important aids in preventing the forming of the egg-eating habit.



Laying House with Scratching Shed.
Favorite Style of Continuous Open Shed Poultry House on Cleft-Rock Poultry Farm, A. F. Hunter, Proprietor.

THE SHED AND CURTAINS.

We made the scratching shed 10x10 feet, and plan for two curtains 4½x5½ feet to close the front. Both these curtains can be hinged to right and left, the right hand one being a door to admit to shed, and thence to pen; or they can be simple curtains on frames secured by buttons, excepting that the shed at end of house must have a door for entrance.

The curtains we have used have been simple muslin (cotton sheeting) tacked to frames of furring strips, the muslin being oiled with linseed oil after being tacked on. One drawback to this is that the oil oxidizes, rotting the muslin in a couple of years, and we purpose shellacing the next curtains we make. A simple process of water-proofing is desirable. A water-proof sheeting suitable for these curtains is usually on sale at seed stores.

We have seen these curtains hinged at top, swinging out and up. This exposes them very much to high winds, and unless they are swung high up they cut off the desired sunshine. The poultryman who tried that plan didn't like it, and doesn't recommend it. A better plan (and probably the best) is to have the curtains hinged at top so as to swing in and up along the roof rafters, where a hook secures them. This plan has many advantages not the least of which is having the curtains hung up out of the way all summer, when they are not wanted. Care has to be taken that the doors between the pens and sheds are cut sufficiently low not to interfere with the curtain; or, rather that the curtains are up out of the way of the doors. Another thing, they should swing well out to front of studs (almost flush with front of studs), and the eight inch wide board at the bottom should be inside of (within) the drip from the curtains, else when it rains against the curtains they will conduct the water into the scratching shed; that must be avoided. We put a six inch wide board along the top of front of the shed, covering end of rafters and front of plate, for finish. A similar board, eight inches wide, is nailed along the bottom, to secure scratching material within and keep water out. If the curtains swing in it would be well to slant this bottom board, from flush with outer edge of sill to within the drip of the curtains, when it would conduct that drip outside the sill.

CONCLUSION.

We strongly recommend this open front shed and closed roosting pen plan of house as being far in advance of all other poultry house plans. We have tried one for three winters, housing thirty birds in a house 10x24, the shed being 10x12, and pen ditto. The birds wintered in that scratching shed house have been the brightest, healthiest and laid the best of any on the farm, and we have come to believe the open front shed and pen the best plan yet. The long house divided into pens 12x12 with a walk at the back is a good house, far and away above most poultry house plans, and has, here and elsewhere, given excellent results. The point we want to especially emphasize is, that the scratching shed house is much better than any other. The open front shed gives fresh air and sun bath, invites to exercise, and promotes the animal well being; it is by all odds the best plan yet.

One objection offered to this plan and size of pen, is that twenty-five birds are too many for one male, hence these large pens are not well adapted for breeding stock. The consensus of opinion favors about twelve females to a male of the medium breeds, and about ten of the larger breeds. We purpose putting twenty to twenty-four females in these pens, having two males for each; running one male in the pen for two days, then the other for two days; the male that is out being in a coop by himself and "fed up" for better service after he has had the rest. This method is employed with excellent results in fertile and hatchable eggs on some farms we have visited, hence it is not an experiment. As not all the pens on a farm are needed for breeding stock, we can cull each pen down to eighteen or twenty females, temporarily increasing the number in the pens unmated.

Some doubts have been expressed, also, as to the adaptability of this open shed plan of house to a cold and windy country. For example, a farmer in central Maine argued strongly against it at a farmers' institute where the writer was lecturing last winter. He said: "Take to-day, for an example. It's been fair, but a fierce wind is blowing and the snow is flying. That open shed would be drifted full of snow in a few hours on such a day as this!" and a correspondent in central New York writes us that "the open front shed would be blown full of snow in no time." In such case we would not open the curtains, and the fowls would have the fresh air of the shed to exercise in, and that fresh air bath is worth a great deal. There are a few days in winter, stormy or blowy, when the curtains would need to be left down; but those days are few—a dozen, perhaps, in a winter. On all other days the sheds can be all open front (the curtains being open by nine or ten o'clock in the forenoon, and closed by two, or three or four o'clock in the afternoon, according to the weather), and being closed on the north and west, gives perfect shelter from our cold winter winds. That word, "perfect shelter," just expresses it, and that perfect shelter means healthy, happy fowls—and eggs in the nest!

LUMBER SCHEDULE.

For house 36 feet long, having two pens and two sheds.

8 pieces 2x4 scantling, 18 feet long; 4 pieces 2x4 scantling, 10 feet long, @ $17	$ 2.10
20 pieces 2x4 scantling, 12 feet long, @ $17	2.72
200 feet 2x3 scantling	3.40
250 feet matched spruce boards, @ $18	4.50
1000 feet hemlock boards	15.00
32 feet 2x3 planed 4 sides, @ $20	.64
2 bundles furring, 16 feet long	1.50
2 windows, 12 lights, 8x10 glass, and frames	2.50
2 rolls Neponset red rope roofing	10.00
2 rolls Neponset black sheathing	3.00
Wire netting, 2 inch mesh	2.00
Waterproof sheeting, 12 yards @ 15c	1.80
Hardware (door handles, hooks, nails, etc.)	1.00
	$50.16

YARD FENCES.

700 feet hemlock boards, @ $15	$10.50
350 feet wire netting, 4 feet wide	5.80
15 10 feet posts, @ 20c	3.00
	$19.30

These prices are taken from our lumber bills, and are adapted to the vicinity of Boston.

PULLETS vs. HENS AS PROFITABLE LAYERS.

The Pullets Excel Yearling Hens and Greatly Excel Three and Four-year-old Hens—Reliable Data from a Reliable Source.

BY JAMES DRYDEN,
Manager Poultry Department, Experiment Station, Utah State College of Agriculture.

AGE may bring reason to the hen, as it sometimes does in the case of man; it may bring her experience and with experience wisdom, as occasionally happens to her owner. But do age with its reason, and experience with its wisdom, assist the hen in the production of eggs? That is the question that appeals to the practical poultryman.

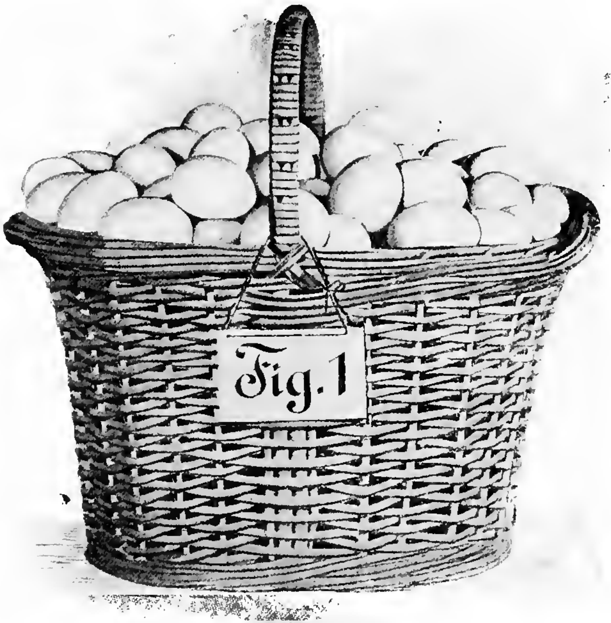


Fig. 1

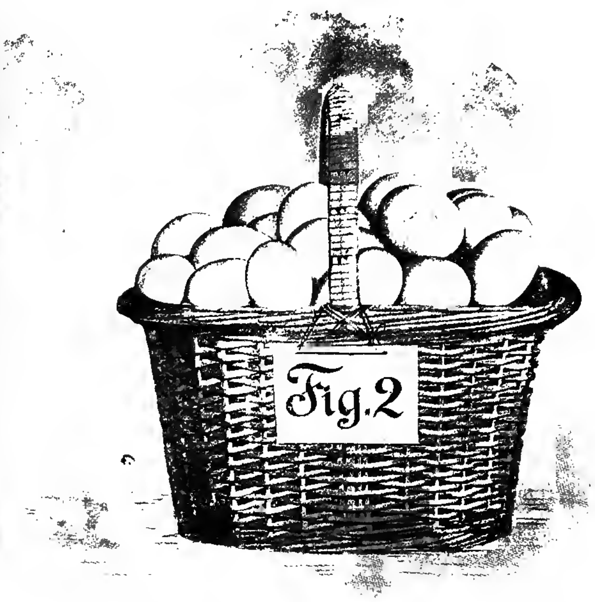


Fig. 2

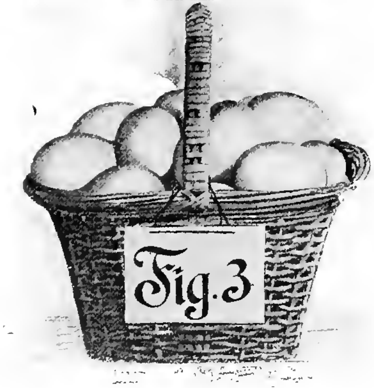


Fig. 3

Having in view the interests of this class of poultry keepers, experiments were inaugurated at the Utah Experiment Station to test the relative egg-producing capacity of hens at different ages. Two pens three and four years old were placed in "competition" with two pens of pullets. The breed was Rose Comb Brown Leghorns in each case, and the strain was the same. There were four fowls in each pen. The pens were 5 feet by 7 feet, and attached to each was an outside yard 5x40 feet.

The following table gives the average results of the experiment for the first year, 1896-7:

THE AGRICULTURAL EXPERIMENT STATION,

Logan, Utah.

EXPERIMENTS IN EGG PRODUCTION.

The baskets of eggs represent the number produced per year by pullets, hens one year old, and old hens, beyond what were sufficient to pay for the food eaten; or they represent the relative per cent of profit on the cost of the food. Fig. 1, pullets; Fig. 2, hens one year old; Fig. 3, hens three and four years old.

	Weight of Food Consumed Per Fowl, in Pounds and Cost of Same.									Number of Eggs Produced and Value.			
	Mash.	Wheat.	Bones.	Corn.	Oats.	Barley.	Lucerne.	Cabbage.	Cost.	No. of Eggs.	Value.	Food Cost Per Doz.	Per Cent Profit.
									Cts.		Cts.	Cts.	
Old Hens (1)....	10	22½	10	6	11	1	5	3	53¼	64	56	9.9	5
Old Hens (2) ..	10	27	10½	6½	14	1	4½	4	62	107	100	6.9	61
Average	...	...	...	...	...	...	...	...	57½	85	78	8.4	33
Pullets(1)	10	25	10½	6	14	1	4½	7	61¼	158	168	4.6	174
Pullets (2).....	10	27	10½	6½	14	1	4½	4	62	182	188	4.1	203
Average	...	...	...	...	...	...	...	...	62	170	178	4.4	188

It will be seen from the above that the two pens of old hens laid an average of 85 eggs per fowl during the year, while the two pens of pullets laid 170, or exactly double the number laid by the former. The value of the eggs laid by the old hens was 78 cents per fowl, and by the latter $1.78 per fowl. The cost of the food required to produce a dozen eggs was 8.4 cents for the old hens and 4.4 cents for the pullets.

The pullets of 1896-7 were continued as one-year-old hens the second year, 1897-8, with the addition of another fowl of like age, breed, and former treatment, to each pen, making five fowls in each during the second year. The results of their second year's work are given in the following table:

	Second Year's Record of Food.							Egg Record and Value.			
	Mash.	Wheat.	Bones.	Corn.	Oats.	Oyster Shell.	Cost.	No. of Eggs.	Value.	Food Cost Per Doz.	Per Cent Profit.
							Cts.		Cts.	Cts.	
Pen 1..........	9.1	35.5	9.6	0.5	18.2	1	62.1	150.8	168	4.9	170
Pen 2	9.1	34.5	9.8	0.5	22.0	1	66.5	114.2	111	7.0	67
Average	...		....	...	......	...	64.3	132.5	140	6.0	118

It is seen that pen 1 laid during the second year an average of 150.8 eggs per fowl, against 158 the first year. Pen 2 laid 114.2 the second year against 182 the first. They averaged the first year 170 per fowl and 132.5 the second year. As pullets their eggs were worth an average of $1.78 per fowl, and as one-year-old hens they averaged $1.40, a difference of 38 cents in favor of the first year's laying. But the profit from the two is another question. Deducting the cost of food in each case we find that the profit was $1.16 per fowl the first year and 76 cents the second year. That makes the percent profit on food the first year 188 and 118 the second.

These figures will afford some basis for a discussion of the question, does it pay to keep hens two years? Figuring on food cost alone there is a very satisfactory profit the second year as well as the first; so that it does pay when food cost alone is considered. But then there are other items of cost—labor, a yet unknown quantity, and interest on investment. The expense of keeping a pullet is no greater than that of a hen, and these figures show that the profit was some 50 per cent greater for the pullet than the year old hen. For ease of calculation, suppose a man can care for a thousand hens. If they are pullets, according to these results, they will yield a profit on food of $1,160 per year. If they are one-year-old hens, the profit will be $760. In the one case the man will have $1,160 for his labor, interest on investment, etc., and $760 in the other case, a difference of $400 in favor of killing off the hens at the end of the first year. As he can care for only a limited number of hens, it would certainly pay him to renew his flock every year, assuming that the cost of replacing the hen with a pullet can be paid with the money received from the sale of the hen. But the life of the great majority of the hens of the country is doubtless longer than two years. If we refer again to table 1, we see that the average value of the eggs produced per fowl of old hens was 78 cents. Their food cost 57½ cents, leaving only 20 cents profit on food. With a thousand such hens there would be left only $200 to pay for labor and interest on investment, as against $1,160 in the case of pullets and $760 for the one-year-old hens.

In the above I have given the data obtained in a two years' experiment. The results may be modified in further experiments which are being continued at the Station.

All pens were fed alike, except as to quantity. A mash composed of two parts bran and shorts and one part each of chopped corn and oats, was fed in the morning. About 10 o'clock a little grain was fed. Three times a week cut bones were fed. Cabbages were fed until about the first of March, after which, and until green grass could be secured, lucerne leaves were fed dry. This was scattered in the pens. During the summer green grass was thrown into the pens. No stimulating food was fed, except a little cayenne pepper in the morning mash. Salt was also used in the mash. During the winter coal ashes were kept before the fowls, also a little gravel. No oyster shells were fed until the middle of summer.

Though it is not a part of my subject, it may be mentioned incidentally that this experiment involved a test of the value of exercise. The pens marked (1) received their grain food in a box; the others (2) were fed in a litter of straw on the floor, inducing exercise.

BEST BREEDS FOR BROILERS.

Valuable Points on Broiler Raising by a Man Who Has Achieved Success in this Line—The Merits of the Light Brahmas, Leghorn-Brahmas, Wyandotte-Brahmas, Barred and White Plymouth Rocks, and White Wyandottes Set Forth.

BY ARTHUR G. DUSTON.

AT THE request of the editor, I am going to present some hints on broiler raising as exemplified by me on my farm in Marlboro, Mass. I have thought best to divide these into two papers—one on varieties and their comparative values, the other on forcing for growth. I believe that many lose courage in raising broilers by not obtaining the right stock.

First, many take Brahmas. They might do far worse. Let us take the Brahma from the egg and follow it. Some claim that Brahmas are superior for this purpose. Yet, in an argument with an incubator manufacturer, a prominent Light Brahma breeder's first and best-proved claim is, that they do not hatch as well artificially as eggs from the American or Mediterranean classes. Does it pay to put eggs in machines that will make the chicks cost, on coming into the brooder house, 25 or 50 per cent more than others?

Once in the brooder, Brahmas prove very strong as little chicks, but look out for leg-weakness, their heavy bodies proving too much for small legs.

Again, any one watching chicks raised artificially knows that they will attain their height earlier than those raised with hens. So a Brahma chick has that against it as a broiler, for long legs with feathers on them hurt a fowl in the market. But, properly taken care of, Light Brahmas will prove fairly satisfactory as broilers. As roasters, which subject cannot be even touched on in this article, they are choice.

Mr. Arthur G. Duston.

While the Brahma is under consideration it seems well to take up two of the more popular crosses made with them, viz.: Leghorn on Brahma and Wyandotte on Brahma.

Leghorn on Brahma have some very good points which are: Yellow skin and legs and fairly plump bodies. They also feather early, but a large proportion of the early cockerels will be so near full blood Leghorn that they would readily be taken for them by a casual observer, and to force them, giving a liberal quantity of meat or ground bone, together with the heat, will develop extremely large combs, which gives the appearance in a dressed bird of its being old—a point against us. Furthermore, the nervous temperament of this cross (taken from the Leghorn) keeps them from making flesh, where other varieties would take on fat.

I have run this cross where at fifteen weeks I could not force at least twenty-five per cent of them to weigh more than from one and one-half to one and three-quarter pounds.

The Wyandotte-Brahma cross is almost ideal, being hardy, low-combed and not getting "stagy" at an early age, as with the Leghorn cross; but, my dear reader, do you know there is something in the feathered leg that is not inviting to the buyer? To see a neat, yellow, breasted broiler with a mess of feathers on the legs and feet will detract from their appearance more than one would think unless he has had the very fastidious market of Boston to cater to. The carcass of this cross is plump and yellow, only a small proportion coming so dark as to have black pin feathers enough to injure the looks.

To leave the Asiatics, we will touch on the Barred and White Plymouth Rocks. The rich yellow legs and bodies of these justly popular fowls, the quick growth, with not enough comb to hurt, gives us a broiler hard to beat—one of the worst faults being dark pin-feathers in the Barred, which are always somewhat objectionable in a broiler, for the reason that they are put on the market at an age when it is impossible to get them all out.

I cannot go through all the breeds, but will only take up those I have honestly tried. This brings me to the last, the White Wyandottes. To be frank, I will state that I once thought of discarding this breed as not fitted for my business purposes, but after "summering and wintering" them, I now feel that I would drop all other breeds before I would the reliable White Wyandottes.

Let us note their faults. The first is that in some birds, more especially those bred for extreme whiteness, you will find they are not yellow-meated. At the same time I have seen the whitest plumage birds have rich, yellow skin, beak and legs. In buying stock look for yellow beak, and as yellow a leg as you could naturally expect at the time of year you are buying; that is, making allowance for a bird hived up in a yard, with sand to dust in, as it will surely bleach them to a flesh color.

Another trouble you may have with the Wyandotte, as perhaps you would have with no other breed, is, confining a large number in a small pen, they easily take up feather pulling. I think this is due to the peculiar way in which they feather. Some will grow to weigh one and one-half pounds before they have any but neck and wing feathers. Then the pin-feathers start all at once, making the habit easily formed by the "chicken act" of striking one another, or picking off any soft food that may adhere to the feathers. But plenty of green food will obviate that to a great extent, especially should that food be freshly cut clover. Of course it cannot be obtained in winter, but well-cured clover rowen can. With care after this warning, you need have no trouble in this direction. Regarding white skin, I will tell you in my next paper how to overcome that by the use of the right kind of food, making it yellow enough to suit any one. Now that we have seen the faults of the White Wyandottes in their worst light, let me extol their virtues as broilers, for they have many. The egg being reasonably thin-shelled hatch as well as any you can get.

They mature as laying pullets a full month earlier than Plymouth Rocks, thus giving you eggs for early hatching.

Their clean, yellow legs, low combs, white pin feathers, and quick growing qualities, render them the best broilers I can put out.

I sold hundreds to dress eight ounces (one-half pound) this year and they were as round as a "butter ball"; this being one of their most important merits, that when properly fed they are always ready for market.

Again, they will stand all the forcing any bird can. If you try to raise Rocks and Wyandottes in the same pen, the experiment will prove to you this fact: Your Rocks will go "off their legs," while the deep-breasted, plump-bodied, smooth-skinned, active little Wyandottes take their medicine five times a day and stand as straight as matches. Remember, it is generally the bird that can stand the greatest amount of food that makes the quickest growing broiler, and must be the bird you should adopt, as every additional day means additional cost from labor, coal and food.

I have written this article from the market point of view, that is, the sales-counter, as that is where our returns come from.

Now, for one moment let us look at the matter as epicures. Take any one of the varieties mentioned above, and the Wyandotte besides having the extra flesh on breast, as I stated before, caused by the great depth of breast-bone, is as juicy and delicious as any, and in the opinion of "our folks," more so, a dish luscious enough for a king.

This is just my experience briefly set before your readers. If I have written anything that will in any way aid my brother poultrymen, I am satisfied.

One word in closing. Do not be in a hurry to cross your stock, as no one can make me believe again that there is anything gained by crossing, for there is no place that a thoroughbred of some variety will not fill the bill, and once you start to cross where can you stop? The labor and skill of years come to naught when you destroy the integrity of a breed or strain by crossing.

A Brooder on the Reliable Poultry Farm.

WHAT AND HOW TO FEED.

In Order to Get Fertile Eggs—In Selecting Eggs for Hatching, Give the Incubator the Same Chance You do the Hen.

BY A. F. COOPER,
Of the Prairie State Incubator and Brooder Co.

IN order to secure good hatches, good fresh eggs are absolutely necessary. Poor eggs, poor hatches; poor hatches, poor chicks; and if poor chicks are hatched a very poor percentage of them are raised. In order to procure good eggs the laying stock must be looked after carefully. Nothing but good, healthy fowls should be kept, and one cannot be too careful in taking care of them in order to produce eggs that will run a large percentage of fertility and produce good hatches, either in an incubator or under a hen. Hens that have to roost out on the trees, on fences, or in a shabby hen house, will not lay many eggs during the winter months, and not twenty-five per cent of them will run fertile. A poor hen house is really worse than no hen house at all. Any building where the wind can blow through, or which gets so cold that the combs on the chickens will freeze, will insure you in each and every instance that it will require but a very small basket to carry the eggs that the hens will lay during the entire winter season. A hen house should be so constructed that it can be kept warm, and during zero weather a little artificial heat should be used in order to keep the chickens' combs from freezing, or the eggs from freezing in the nests. The breeder should also be particular to mark each and every egg that comes from the different yards in order that he may ascertain the fertility of the same, and if he finds one or more yards that are showing up a small percentage of fertility, then the male bird should be changed.

MR. A. F. COOPER.

The feeding of laying hens is no secret, but, on the other hand, there is considerable in the "knowing how." Overfed hens will lay eggs that invariably fail to produce good hatches, and when the breeder notes soft shells or deformed egg shells, he should know at once that he is overfeeding his hens and a change should be made. We are strong advocates of having plenty of litter in a poultry building. We have never found anything better than oat straw. Cover the floor of the building with at least a foot of it, and scatter their grains in the same. In this way it gives the hens plenty of exercise through the day, thus keeping them warm and in a healthy condition. Avoid feeding much soft food when eggs are wanted for hatching. On the other hand, feed whole grain, such as corn, wheat, buckwheat and oats in connection with ground meat and bone.

Feeding soft food is in our opinion, where a great many make a mistake during the early season. The egg production may be increased by feeding a mixture of egg food, poultry powder, pepper, etc., etc., but the eggs will not hatch and a much larger percentage will die in the shell at all periods of incubation. Forced egg production injures their vitality. Experience has taught us to entirely discontinue the use of all such stimulants when eggs are wanted for hatching. If the breeder will only be as careful in trying to produce eggs as he is after he gets them, there would be no trouble. We admit that in the early season when eggs are very hard to get, too many operators set eggs that will not hatch under any circumstances, either in a machine or under hens.

Do not place eggs in an incubator that you would not place under a hen. For example, when you go to your basket to pick out eggs to put under a hen, no difference if there are fifty or more eggs in the basket you will pick out thirteen or fifteen, as the case may be, of the nicest eggs that you can find. Not so with the incubator, for when you come to set it and eggs are scarce you will put in one hundred or more eggs of different sizes and deformed shells, and, many times, chilled eggs. They fail to hatch and then the incubator gets the blame. Place eggs in the machine that are as uniform in size as you can get them. Feed your laying stock carefully and provide warm quarters for them.

Do not feed soft food over twice a week, then feed it in the evening. We know this statement is contrary to many authorities, yet in the meantime our experience has taught us that in the evening is the time to feed soft food. If you feed it in the morning the chickens will fill their crops, go sit down on the roost, and take no exercise through the day, while if you feed it in the evening they go to roost and in the morning they are ready for a good breakfast of solid grain food. Figure on plenty of exercise for your laying stock, as there is about as much in that as anything else. Feed them green food the same as you would broilers. Hang up a head of cabbage in the hen coop, a piece of meat, turnips, beets, or anything of that nature and let the chickens pick it off. This furnishes them plenty of exercise through the day, in connection with feeding them grain in their litter in the poultry buildings.

Have a system for doing your work. Clean out your poultry buildings regularly. Water the chickens often and feed them as regularly as you would expect to eat yourself, and you will be able to carry good healthy stock, which means good eggs, good hatches and a large percentage of vigorous chicks.

Kindly let us repeat that in setting eggs in incubators, give the machine the same chance you do the hens, and select nothing but the best.

HATCHABLE EGGS—HOW TO GET THEM.

The Importance of Having Good, Vigorous Breeding Stock—Proper Housing, Mating, Feeding and General Care.

BY M. K. BOYER,

Author of "A Living from Poultry," "Broilers for Profit," and other Poultry Books.

THE success of artificial incubation dates back to the production of the egg, and the conditions under which it was produced. It has been said that it is much easier to hatch an egg than to raise the chick. There is much truth in that declaration, and yet if we are unable to properly raise the young, it is more the fault of the condition of the egg than the brooding system. Strong chicks come from strong eggs, strong eggs are produced by strong fowls. In other words, we cannot expect rugged chicks to be the product of delicate parents. It is true that poor incubation will weaken the chicks, even if from hardy and vigorous parents—but we are supposing that the incubation part has been properly performed.

Some years ago, when the broiler fever was at its height in Hammonton, N. J., as many as forty broiler establishments were in full blast. Eggs were in great demand, as very few of the broiler men raised their own eggs. There were all sorts of conditions in those eggs, and there was any variety of methods employed in getting and keeping the eggs before delivery. Even in the coldest weather the farmer did not deem it necessary to gather the eggs before night, and it was rather a common affair—even in the mild climate of Southern New Jersey—to buy up a lot of chilled eggs. An egg does not need to be cracked to be chilled. We have seen as high as forty-five cents a dozen paid for eggs, and not an average of two chicks hatch from every dozen of eggs purchased. Besides the condition of the eggs was the nature of their contents. By that we mean the variety of blood that produced them. Buying up eggs here and there and everywhere, gave pure Leghorns, from one person; pure Plymouth Rocks, from another person; pure Brahmas, from another; Leghorn crosses, from another; mixtures ad libitum from others, and so on. They were all placed in the same incubators, and, of course, given the same treatment. Sometimes the test would be satisfactory; very often not. However, as a rule, the hatches were disappointing. When the time of hatch was due the Leghorns and the Leghorn crosses would be out of the shell, but the Plymouth Rocks and Brahmas, and American and Asiatic crosses, would either lag behind or die in the shell. At that early day it did not occur to the operators that eggs from one variety, in the same incubator, gave the best results. Another drawback to this buying-up policy was the fact that part of the product would be yellow-skinned, others white-skinned, others neither white nor yellow. Some of the chicks were rose-combed, some pea-combed, some with combs large enough to do credit to old fowls (in forcing the broilers considerable meat was fed, and, in consequence, the comb and wattles grew to large size). The legs, too, were of all colors—white, yellow, pink, blue; some clean of feathers, others with feathers in profusion.

When about to market them, the broiler raiser, owing to the variety of bloods that he had to contend with, could not take up a whole pen for killing. We have seen but ten birds up to the desired weight, out of a collection of fifty; and have seen six weeks intervene between the marketing of the first and the last of such a flock. All this was a waste of feed and time, and all owing to the conglomeration that was in those pens.

There is one fact that no broiler raiser will dispute, much as they may differ in other matter: no success can be attained in the broiler business by the use of dunghill fowls. And what is true of broilers is equally true of roasting fowls.

So the raisers of broilers or roasters must either accept one variety of thoroughbreds, or resort to a systematic cross. Some years back we preferred the cross-bred to the thoroughbred fowl, for the reason that we could get quicker-growing and more plump carcasses from a good cross than we could from any of the thoroughbred varieties, not even excluding the popular Plymouth Rocks. To be honest, we have yet to find the breed that will give the quick growth and plumpness that we can find in the Wyandotte—especially the White variety. At almost any time of chickenhood you will find the Wyandotte plump. For roasting purposes (young chickens weighing three to five pounds each), we are inclined to favor the Plymouth Rock. They give a carcass of about the right size—not too small and not so large as to interfere with that of the Brahma. For large roasters the Light Brahma fills the bill better than anything we have yet tried.

An excellent cross for broilers—and it is about the most satisfactory in every way of those we have tried— is Houdan crossed on Cochin (Partridge preferred). The chicks grow rapidly and plump up in nice style. They make a very even lot, too—while the flavor of the meat is of that juiciness so highly prized by epicures. Indian Game crossed on Brahma or Langshan, too, makes first-class broilers, but the objection to using a black-feathered bird is the white skin and dark pin feathers. Wyandotte crossed on Brahma was a more recent test. It is a good one, but no better than the Wyandotte in its purity. The chicks will be apt to be feather-legged, which is an objection. White Leghorn crossed on Plymouth Rock, and White Leghorn or Light Brahma, were popular at one time with broiler men, but the large single combs would crop out in the cockerels. The objection to a large single comb is, that it is apt to carry the conviction that the bird is older than a broiler should be. We once tried the cross of Black Minorca on Black Langshan, for a special trade in New York City, where white-skinned birds were wanted. We got a fine broiler so far as growth and plumpness were concerned, but oh, horrors! when we think of the black pin-feathers and the sight the carcass presented after cleaning! We avowed never to use it again. The last lot we would not market, but allowed them to grow up for layers. It was here that they redeemed themselves—we never had better layers than that cross gave.

So our advice is, select a desirable breed or cross, and stick to that alone, and you will find the eggs to hatch better and you will have a more uniform lot of chicks. The most profit comes when you can market at least three-fourths of a brood at from twelve to sixteen weeks of age. To keep them beyond that limit will cut very much into the profits.

MATING UP THE PENS.

Mate up your breeding pens with the same care exercised by the fancier who is breeding for standard markings. Select hens that show a plump breast and broad back, short legs, and such hens as have never been sick. It is imperative that none but strictly hardy stock should be used. Secure a male bird that possesses the same qualities as are found in the hens, and one that in no sense is related to any of the females. Get a new male every year. Above all things, avoid inbreeding if you would have rugged offspring. Nothing under one year of age should be used, while two-year-old hens mated to one-year-old cocks will give the best results. For strong fertility, three cocks to two pens, or two cocks to one pen, will be found excellent. We prefer the three males for two pens. Our plan is as follows: Cock No. 1 to-day is in pen No. 1; cock No. 2 in pen No. 2; cock No. 3 in a pen alone. To-morrow cock No. 1 goes to pen No. 2; cock No. 2 goes to a pen alone; and cock No. 3 is put in pen No. 1. So they are changed each night, until through breeding, when the males are entirely taken away from the females and kept separately.

In the case of two cocks for one pen, we alternate them each night, never allowing the two males with the females at the same time. Where we use cock birds in alternation, as described, we find we can use more females in a pen, providing in doing so we do not overcrowd. The past season we used matings as follows: Light Brahmas, fifteen females; White Wyandottes, twenty females; and in a pen of White Leghorns, kept solely for eggs (for hatching and table use) we used thirty females. So by alternating males we have a gain in females to pay us for our trouble. Our eggs ran from 80 to 95 per cent in fertility.

The secret of this plan is this: Hens with one male for the season are mated according to the ideas of the owner, and not according to the likes and dislikes of the hens themselves. When the male is compelled to force his attentions on the female, the power is lost. In every case where the invitation to copulation is extended by the hen, fertility is assured. By changing males the chances are increased that the new male will be more to the liking of the hen than the rejected suitor. Again, on the part of the male, he is apt to have his favorites, shunning the rest. In consequence, we get fertile eggs from the one class, and infertile from the other. Again, the male resting one day out of three will make him more vigorous and keep him in a better condition. One male in a flock the entire season is apt to become sluggish. In such cases it is not uncommon to have one lot of eggs hatch well, and another lot from the same pen give poor results.

FOWLS SHOULD BE KEPT BUSY.

But there is another point that must not be lost sight of in order to produce fertile eggs. Even if we keep on changing males we cannot expect the best of success if we allow our hens to idle away their time. They must be compelled to exercise. Exercising keeps them in prime condition, it warms up the blood, and it aids digestion. All this is of great importance during the long winter months. For that reason we want our breeding stock yarded. We believe in generous sized runs—not less than one hundred feet in length, and as wide as the pen will permit. We likewise want a scratching shed attached. We keep these scratching sheds bedded at least four inches deep, and when we throw the grain among the litter it at once falls out of sight. But the hens find it; they scratch, and peck, and sing—and thus busy themselves from morning to night. These sheds we have so arranged that the hens can enter them the first thing in the morning, as soon as they leave the roost. When we close the houses at night we scatter several handfuls of wheat among the litter which the hens work for before we have their breakfast ready. There is a double benefit in this,—they get a better appetite by their working, and it gives us a chance to first attend to the wants of the brooder chicks. It is about eight o'clock before they get their mash, and they are none the worse for it, as they have found sufficient grain among the litter to partially satisfy their hunger, and prevent worrying for food.

Outside in the runs we have a space about one-quarter the length of the yard, which is also thickly bedded with litter. When we go to feed the mash (if the weather is not stormy, and if there is no snow on the ground) we let the fowls out in their runs and give the mash in troughs. Should the weather be stormy or snow on the ground, we feed them indoors, and raise the curtains in front of the scratching pens so as to let in the cold air. We never allow the fowls out in other than clear weather. Don't be afraid of the cold; hens exercising can stand more of it than the average man. We might add that our scratching sheds are enclosed on the south side with one-inch wire netting, and a curtain on a frame covers this at night, so as to prevent snow or rain from driving in should a storm occur. At noon on bright days, we scatter grain among the litter outside, and do the same in the evening, at least an hour before dark. [Note—For style of house with scratching sheds, recommended by Mr. Boyer, see article entitled "Laying House with Scratching Shed," page 27.—Ed.]

WHEN TO FEED AND HOW.

The quality of feed is as important as the quantity. In the daily bill of fare we use wheat and oats, with their by-products, bran, middlings, and oatmeal (or ground oats), and corn meal. We use whole corn only at night during very cold weather.

Our morning mash consists of bran, middlings, corn meal, and ground oats, generally equal parts by measurement, but varied according to condition of droppings. To this we add about half the bulk (more when we think it necessary) of either cut clover hay or clover meal. About ten per cent of animal meal is also added. Twice a week powdered charcoal (heaping tablespoonful to a quart of mash) goes in the mixture. We give a limited amount of mash to each fowl. We have a large iron spoon, such as housewives use. We throw in the trough one spoonful for two fowls.

At noon we scatter one good handful of grain in the litter for each fowl. We feed oats and wheat alternated—barley, when we can get it, for variety. We soak the oats in hot water for several hours before feeding, on account of the hulls, and the fowls also relish it all the more.

In the evening we give one handful of grain to each fowl (which is double what they get at noon). For this feed we use the same grains as at noon, only alternated. If we feed wheat at noon, they get oats at night, and so on. During very cold weather we make the evening feed corn.

Every Wednesday and Saturday we give in addition, a feed of green cut bone. On those days we do not give the grain for about an hour after giving the bone. We also feed cooked vegetables, cabbage and chopped onions whenever we can get them.

We keep grit and oyster shell constantly within reach, and fresh water is given twice a day. In the morning we water after we are through feeding. We add enough hot water to it to take off the chill. The water at noon generally will not be too cold for them. We find that if given water after feeding the bowels keep in a healthier condition, and digestion is better.

The premises are kept perfectly clean—droppings are collected every morning. Dust baths should be provided, although with us the sand in the scratching shed is always loose enough for the fowls to dust in.

We gather the eggs several times a day, so as to prevent chilling. They are carried to the house cellar where the temperature runs from forty to sixty degrees. We place them on racks made purposely, and turn the eggs every other day. They rest in the racks end down. Under no circumstances would we keep them piled up in boxes and baskets. We also make it a rule never to set an egg that is over three weeks old, and the fresher the egg the better we like it. We select for hatching only those uniformly shaped—never any too large, or too small, or those having ridges in them, or those out of shape.

To briefly sum up the management: We have our fowls warmly and comfortably housed. They are regularly attended, are kept exercising, are mated to vigorous males, are accommodated by males more to their choice, are fed as much of a variety as possible, are never overfed, are kept from exposure to inclement weather, are never allowed to worry, and are always kept in good health. The eggs are collected four to five times a day, are kept in a temperature not colder than forty degrees, are turned every other day, and only the best shaped eggs are used for incubation.

SUGGESTIONS ON BUILDING INCUBATOR CELLARS.

BY A. F. COOPER,
Of the Prairie State Incubator Co.

INCUBATOR cellars should be built, in a measure, to suit the climate. What would be a practical plan in the extreme north or middle states would not be suitable for the south. The builder should take into consideration the location of his incubator room. If in a light, sandy, porous soil there is no trouble to secure a dry floor, but in the ordinary soil, especially in a flat location, an incubator cellar should not be built very deep, but about like that shown in the plan (see opposite page), that is, 18 inches to 2 feet, and the dirt that is taken out of the pit should be thrown back against the walls. This practically gives an underground room with but little depth below the natural surface.

An incubator cellar is preferably covered with another story or at least a small attic. A second story is better, as it adds but little to the cost and makes an excellent storage room which is needed upon any poultry farm. On the duck farm this room is used as a feather curing room. The heat and warm air coming up from the incubator cellar aid a great deal in the drying and curing of feathers. Upon a chicken and broiler farm this room can be used for the storage of almost anything. The object of this additional story, or attic, is to prevent the heat of the sun from coming down into the incubator cellar.

An incubator cellar should be well lighted, and when possible it should be constructed so as to get the principal light from the north, so that at no time will the direct sunshine come into the incubator room. This should be guarded against, as a beam of light striking an incubator full of eggs will go through the glass doors and overheat the eggs. Of course this will not apply to incubators that are provided with an outside wooden door, but it is best at any rate not to allow the sun to enter, as it has a tendency to warm up the air. The best incubator room is the one that shows the least variation in temperature, and they should be constructed with this object in view. In a rolling country where a hillside can be secured, an excavation on the north side of the hill makes an excellent incubator room and has the advantage of not requiring any outside steps, as the door will open right into the room, and it is exceedingly easy to drain. No water can possibly stand on the floor. In a damp location the floor and walls should be cemented with the best cement, up above water level to keep out the dampness.

The ventilation should be well looked after. In cold weather all the ventilation required will be secured by the ventilators shown in the illustration. In moderate weather it may be occasionally necessary to use windows. They should be hinged below so as to open at the top and allow a free circulation without draft. In the south or in a warm climate, it is advisable to have a large opening in the ceiling extending out through the roof so as to produce a strong current of air.

Endless modifications can be made in the construction of incubator cellars. Either brick or stone may be used for the walls. The main point is to secure a uniform temperature and a dry room. Eggs can be incubated in an incubator cellar in hot weather when it is hardly possible to incubate them any other way, owing to the outside temperature rising too near the hatching temperature of the eggs, and it has its advantages in extremely cold weather, as an incubator cellar will not fall much below fifty-five degrees in extremely cold weather, and the result is it costs that much less to run the incubators, as not much oil is required.

BUILDING AN INCUBATOR CELLAR.

Importance of Fresh Air—How a Cellar without Ventilation Failed in Its Work.

BY ARTHUR G. DUSTON, MARLBORO, MASS.

I THOUGHT that I might say something to the readers regarding incubator cellars that might be of help to them—not that I can tell them the exact things to do to insure success, but rather tell them what not to do to insure failure.

I formerly ran my machine in a house cellar and had the average success. As I increased the number of machines, I saw that in order to obtain the best results it would be necessary to operate the incubators in a cellar built for that purpose, so in the fall of 1895 I began the cellar.

My lawn on the south and at the rear end of my dwelling sloped off abruptly about four feet. I purposed digging into this bank to the depth of two and one-half feet, thus putting the roof of the cellar on a level with the lawn. I laid it out running parallel with and adjoining the house, with a door leading from the house cellar into the incubator room. I put in a bulk head (a horizontal or sloping door) giving entrance to the cellar from the outside, constructed like a porch with the roof extending out, furnished with two sets of doors.

I had planned my cellar to hold eight 600-egg machines, two rows of four machines each, with an aisle between, and to my notion this plan looked elegant on paper. The walls I had constructed of stone two feet thick, laid in cement. The roof was made of 2x10 feet cross beams and 8x8 inch joists supported by three-inch iron pipe posts. For the covering for roof I used two-inch plank and on top of that tar paper. About an inch of concrete for the floor completed my cellar.

I started a machine or two, and the result was that in a short time all the oxygen in the room was consumed and there was no arrangement for a fresh supply. I sent for a practical man on the ventilation subject and he said he thought that a ventilator of about fifteen inches in draft, running up through the roof, with an opening at the top and bottom, and an equal amount of ventilation secured from the doors, would remedy all difficulty. So I went to work on his suggestion. The doors had a diamond shaped opening at the bottom, and as the outside door was two feet higher than the inside door, it prevented a direct draft. When the wind way from the northeast this plan of ventilation worked to perfection, so much so that a handkerchief would go sailing up the pipe when held at the opening. But when the wind was from other quarters, the ventilation amounted to nothing unless I opened the door leading into the house cellar. Of course if the ventilator pipe were run up about fifty feet it would always draw, but I hesitated putting so unsightly a contrivance on my lawn.

Well, I worried along all winter and did not get a satisfactory hatch during all that time. I did, I believe, get a pretty fair hatch in July, when I ran the cellar with all the doors wide open! I am not prepared now to say just what my hatches for the year averaged. I had new machines, a new cellar, and, suffice it to say that the broilers I was able to ship as a result of my work did not at any time cause a glut in the Boston markets. I do not, however, assign all my failure to the cellar. I know that that year was a bad one for fertile eggs, as I tested eggs bought from three different breeders and got the same results. I succeeded in raising enough birds for breeders, and made up my mind that before the machines were started again I should have something done.

In December of the next year I had a carpenter come out and raise the whole roof two feet, put in supports, paper and clap-board the outside and sheath up inside. I put in a window on the north, one on the east, and two on the south, which enable me to ventilate just as much or as little as I please. As a result of this arrangement, hatches made in this cellar now give the best of results. The windows are only common cellar windows and are hinged at the bottom, so they may be dropped as much as desired by means of a cord.

From my own experience, I firmly believe that a great proportion of the poor hatches to-day are caused by the poor air in cellar and incubator. I know that an egg in process of incubation must have fresh air just as much as a hatched chicken in a brooder must have fresh air, and I also know that a hen as well as an incubator can overdo the matter of incubation. Keep your machine clean, with plenty of fresh air in the room, and do not, I pray you, buy a machine that has not a good system of ventilation. When all these points are observed, I believe the common complaints will in a measure cease, always assuming ordinary intelligence is exercised.

CONSTRUCTION OF BROOD HOUSES FOR CHICKS.

By A. F. COOPER,
Of the Prairie State Incubator Company.

ALL users of incubators and brooders in time feel the need of a properly constructed brood house, and they should carefully consider in their plans the questions of convenience and ease of caring for the chickens, and should provide an arrangement that will enable them to raise the largest possible percentage with the smallest expenditure of money in first cost of building. A practical brood-house may be made of quite inexpensive materials. The plans and internal arrangements are endless. A few points only are essential and we will bring them up in their proper places.

Brooder-houses may be of any length, single or double. The usual rate of capacity is five lineal feet of brooder per one hundred chicks. The width of a single house should be thirteen feet and a double house twenty-four feet. A few feet more or less in width will make no difference. These are average widths.

The alley, in either a single or double brood-house, should be of sufficient width for the attendant to carry a pail in each hand without having to walk sideways. This is a small thing, but is a great aid in feeding and watering. In a double brood-house for broilers, the broods are placed on each side of the alley. A young duck does not require as much heat as a chick. A wire fence in a duck brood-house is not needed between the pens so that one heating system can be run through the center of the building and a walk made on top of the brooders. In making the alley on top of the brooder pipes, the width of an alley is saved from the width of the building.

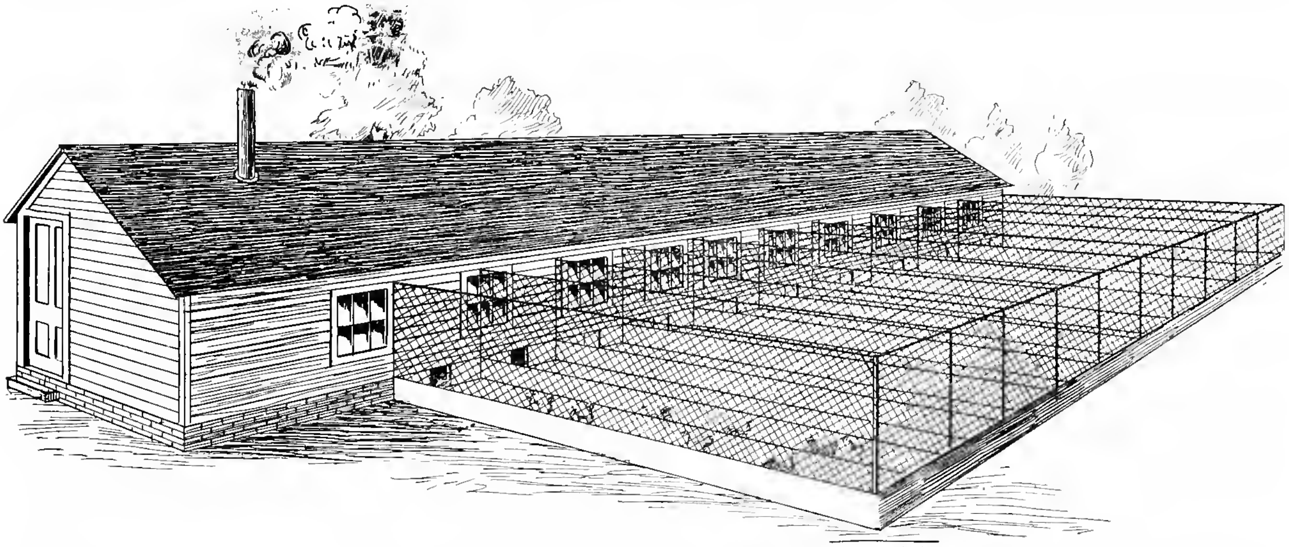
The roof may be of shingles, slate, tin, or sheet iron. We do not recommend the use of paper, felt, or any of the composition compounds for the reason that they are frequently blown off during storms and the chicks get wet and chilled, and the whole brood will be lost in consequence.

The height of a brood-house should be low to save heat and bring the heat down near the floor where the chicks stay. A low house is the easiest to heat. A building should be just high enough for the attendant to walk through, the alley being in the highest part of the building.

Glass should never be put in the roof; always under the eaves. Ordinary sash can be used, made to slide or swing so that they can be easily opened in the summer time, the outside of the windows being covered with wire netting to keep out animals. In a double brood-house, when the building stands north and south, the glass should be on both sides; but in case the building runs east and west, the glass is put under the eaves of the south side, and along the center of the building there should be a verticle offset in the roof and glass put along it so that the rays of the sun will reach the pens on the north side.

No ventilation is needed in the winter time beyond that which is accidental. In the summer time the glass sash are opened and this provides all the ventilation required. This is one object in putting them under the eaves. In case they are opened the rain does not get in as it will when the sash are placed in the roof, if left open accidentally.

Foundations may be of brick, wood, or stone. Brood-house floors should be of earth, sand or gravel, filled in at least six inches higher than the ground outside, so as to get a dry floor. In a sandy location when troubled with rats digging down under the foundation, if a one-inch mesh wire netting, one foot to eighteen inches wide, is buried around the outside of the building, making an underground fence, it will keep the rats out. They dig down to this netting and as they cannot get through it they never think of digging under it as they would a board or solid foundation. Walls may be constructed of rough boards and batten, or tongued and grooved boards, as the fancy of the builder dictates. The inside, if made of single boards, should be lined with paper, and if of double boards the paper should be put between. The object of using paper is to make the building wind proof. This is something that should be done.


Exterior View of Brood House for Chicks.

Inside the house the partitions between the various pens should be constructed of fine wire netting, as laths or a solid partition darken the building too much. In the winter time the sun is low down and strikes the windows obliquely, and by having the partitions made of wire netting it allows the light to go through.

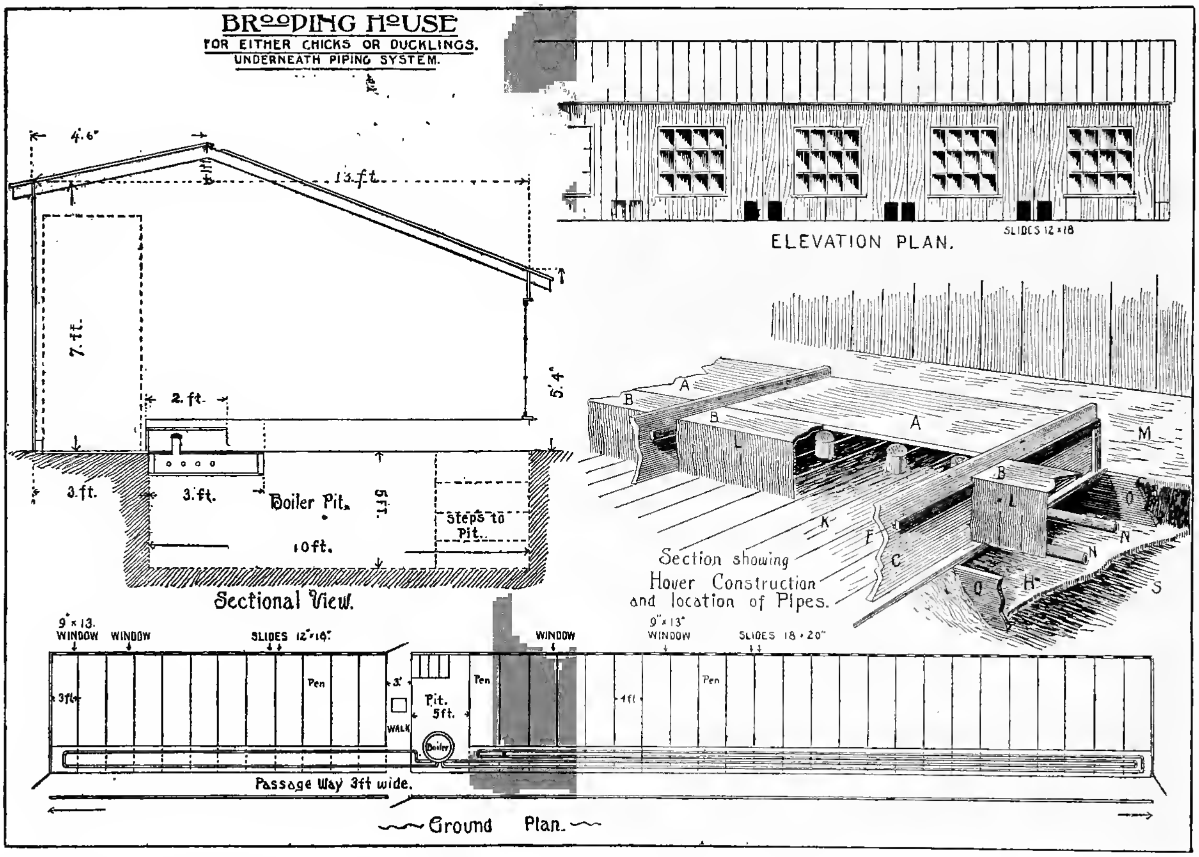
Your brood-house now having a dry earth floor, glass under the eaves, air-tight walls, and a water-proof roof, the next essential is a good brooding system. In a small brood-house sectional pipe brooders may be used, but on a large scale the hot-water pipe brooders, burning coal, or a combination of both systems should be used. The end of the brood-house should contain a shallow cellar or pit for the heater, the depth of this pit depending upon the size of the heater, running from twenty to thirty inches in depth. Around this heater can be arranged feed bins, a place for coal, or any of the various utensils and labor-saving devices that the attendant uses in his work, making the house convenient and not adding to the cost in any way.

See diagrams, presented herewith, of brood-houses for chicks and ducks, also double-loop pipe system and houses in which sectional brooders are to be used. All diagrams are drawn to scale, are carefully lettered and accompanied by bill of lumber, hence should be easily understood. Any carpenter can make an accurate estimate of cost of same, and can build the house.

BROODING HOUSE—UNDERNEATH PIPING SYSTEM.

THE brooding house illustrated in the accompanying plan is 140 feet long and 13 feet wide (see ground plan) and is separated into two parts, 36 feet and 104 feet respectively. The shorter end has twelve pens of three feet each in width and ten feet in length including the hover, and the longer end has twenty-four pens four by ten feet in size. The furnace pit and a narrow walk separate the two lots of pens and an aisle three feet in width extends the entire length of the house back of the hovers.

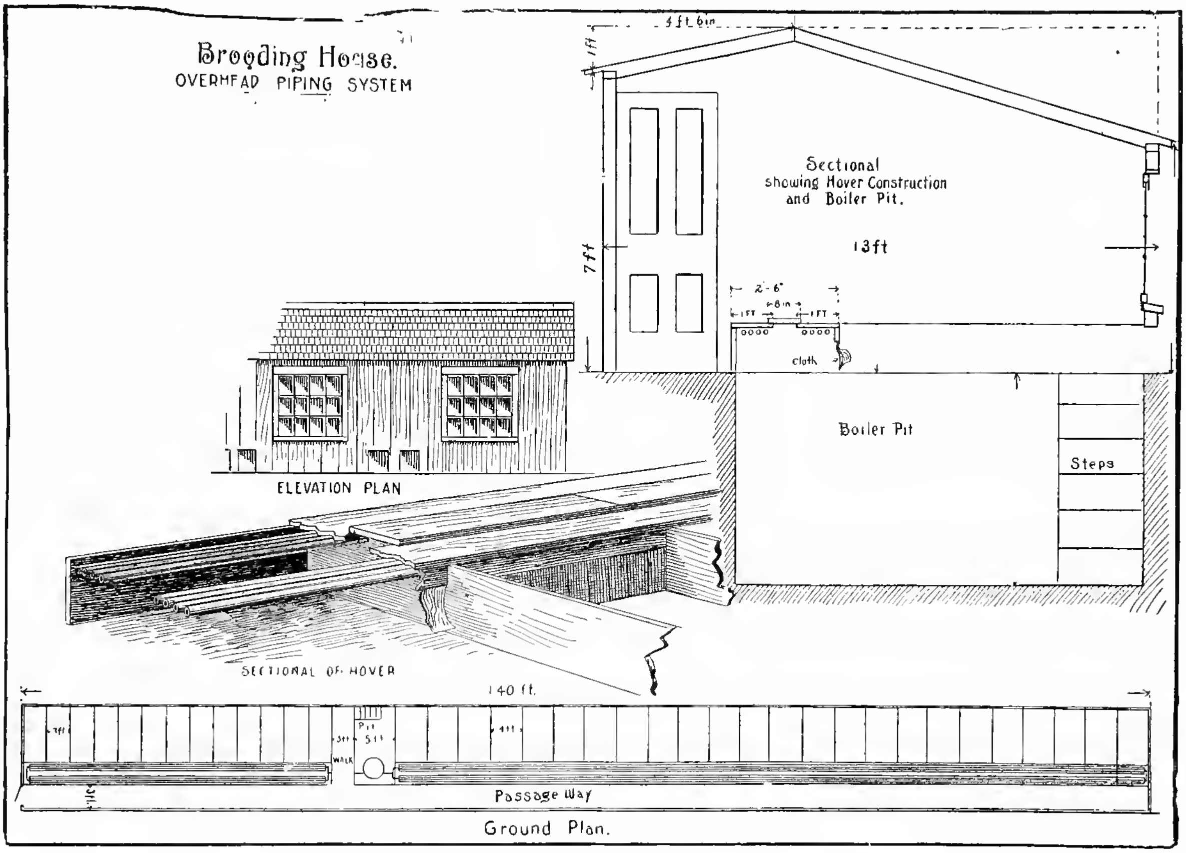
The system of piping is under the hover floor in a trench (see N. N.). The shorter end has a 2-inch flow and return pipe heated by a Winchester heater. The long end has two flow and two return 1½-inch pipes (see ground plan), and both sides are controlled by valves near the heater, whereby all, or a part of the flow may be shut off from the pipes. The trench is made by excavating to a depth of six inches and thirty-six inches wide. The sides are 2x6 inch spruce plank, set on edge (OO). The bottom of the trench is cemented (H). The top is boarded with a course of rough 1-inch boards, and covered with a layer of matched spruce flooring seven-eighths inch (K). This double boarding takes away any danger from too much bottom heat. The boarding comes flush with the edges of the 2x6-inch and the frame work of the hovers is secured by 1x3-inch posts nailed to the outer sides of the 2x6, which are only as high as the hover divisions (C), which in the small pens are ten inches and in the large pens twelve inches high.



This gives a house entirely free from inside posts and makes possible a view of the whole interior from any part. The hover floor is three feet wide (the width of the trench) and in the 3-foot pens the hover top slides on cleats (F) six inches from the floor. The top or cover is only twenty-four inches wide, which leaves twelve inches of the slightly warm floor in front of the hover curtain, making a splendid resting place for the little chicks or ducklings which they evidently enjoy. When first they are put in the hover they are penned back nearly to this floor and the gentle warmth helps them and keeps the floor free from dampness. The cover being in two parts (A and B) and sliding freely on cleats (F) may be readily adjusted so as to give ventilation at the back, front or center of the hover, or all three, and the surplus heat may escape in the same way.

The hover floor is kept littered with chaff or shavings and when the pen is to be cleaned the hover top is removed, the back board which sets between the cleats can be taken out and the litter swept into the aisle and taken thence in barrels. When the little birds are to be changed from pen to pen, the back boards are taken out and they are driven down the aisle from one pen to another, which in the long end of the house are four feet wide and the hover eight inches high, but are otherwise the same as the short end. The illustration shows a hover closed, one with the top partly cut away and one with the top off and the back out, ready for cleaning.

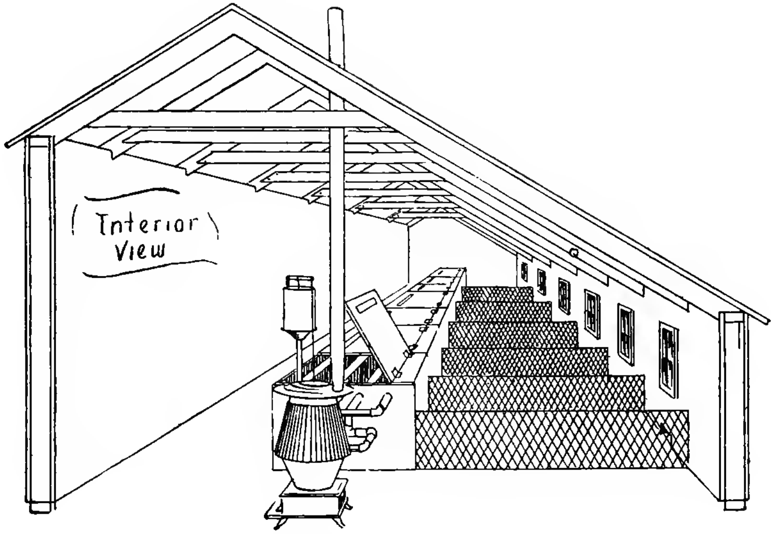
The hot air is admitted to the hovers through the upright 1¼-inch pipe seen in the lower floor. These pipes reach nearly to the cover of the hover and the bottom ends just reach through the board floor, being flush with the under side. Back of each second hover (on the division post, so as to be out of the way), is a 2x3 air box which reaches down under the 2x6 side and permits the cold air to enter the trench. This gives a chance for the warm air in the trench to rise through the short, upright pipes under the hover and draw in cold air from the aisle, making a perfect circulation. The warm air strikes the hover cover and deflecting, makes a perfect warm box on all sides of the little bird and yet exposes his body to no direct heat. The variation allowed by the slide cover permits of ventilation and the escape of surplus heat at the will of the operator. In very hot nights the cover may be removed altogether. For the older birds no curtain is supplied for the hover front, and this arrangement leaves the front entirely open in warm weather.

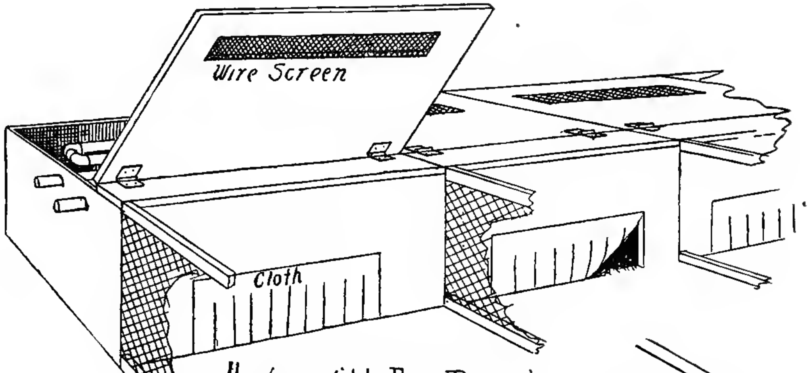


BROODING HOUSE—OVERHEAD PIPING SYSTEM.

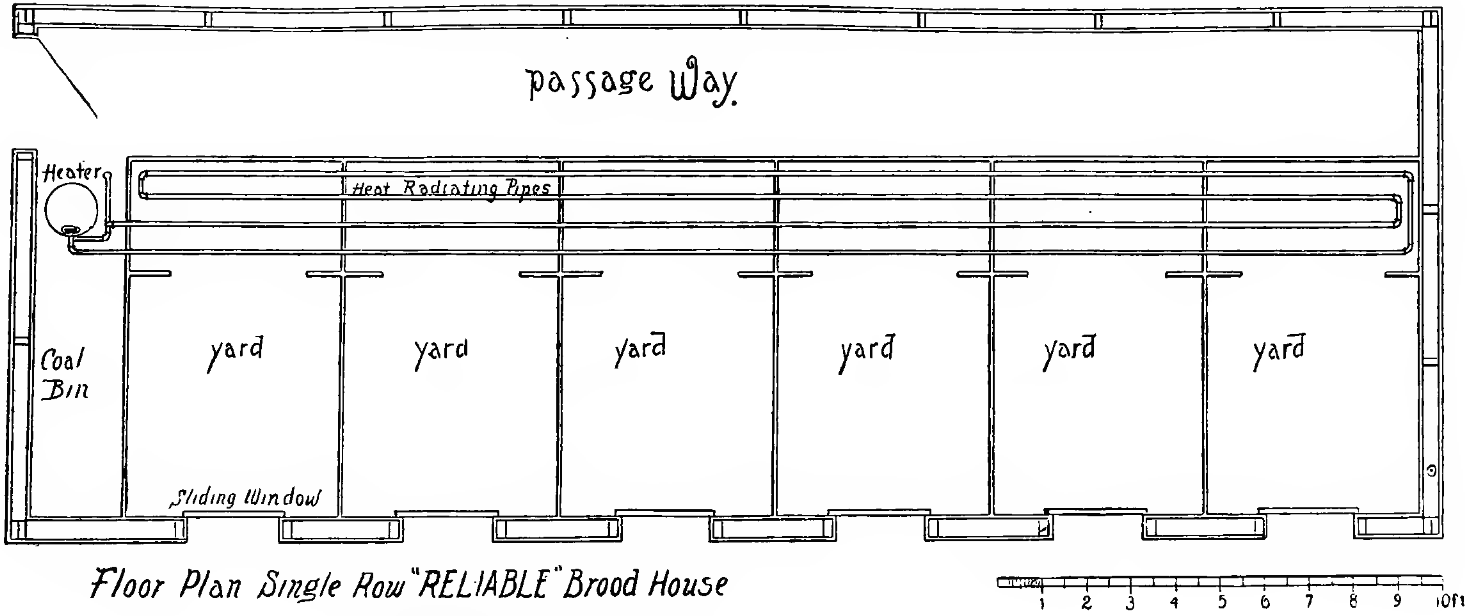
THIS brooding house may be built exactly like the one containing the underneath piping system described heretofore. The only difference is in the arrangement of the hot water pipes and the necessary difference in the construction of the brooders. In the accompanying illustration the overhead piping system is used. The construction of the hovers is very simple. The back is formed of one-inch boards twelve inches wide and the divisions between the brooders are made of the same size boards, in which have been bored eight holes to receive the four flow and four return pipes. A narrow board is let in to the division boards two feet six inches from the rear wall of the brooder. To this is tacked the felt which hangs to the floor of the brooder and is slacked for the accommodation of the chicks in passing to and fro. Over the pipes are placed foot-wide boards and resting on the edges of these are boards which bridge the opening. By moving these boards, which are loose, ventilation may be obtained at the back, front or middle of the hover, and the cleaning of the brooders is greatly facilitated. This is quite a saving on a large plant.

In the short end of the house chaff or sand is placed in the brooders to the depth of five or six inches, so that the smallest birds are brought near the pipes and as they grow the amount of litter is decreased, thus giving them more room and taking them farther from the heat.

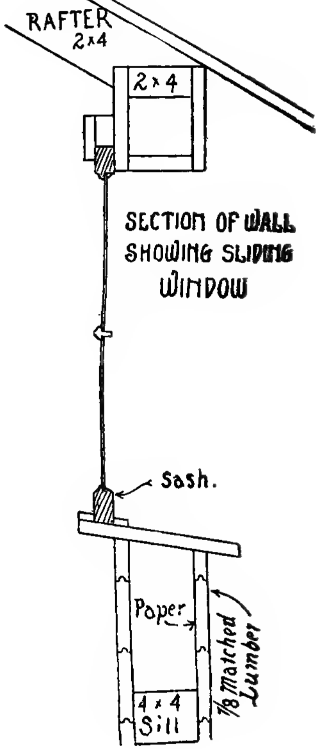




Hover with Door Raised
Showing Heating Pipes



Floor Plan Single Row "RELIABLE" Brood House
DESIGNED BY
Reliable Incubator & Brooder Company Quincy Ill



SECTION OF WALL SHOWING SLIDING WINDOW

SINGLE ROW RELIABLE BROODING HOUSE.

On opposite page are shown drawings of the single row Reliable brooding house, a house that embodies the best ideas to date for a single row house. This house can be built in any length, the usual width being twelve to sixteen feet, sixteen feet preferred. This gives room for a four foot aisle along the rear wall of the house, for brooders two and a half feet in width, and for inside yards or runs nine and a half feet in length. These inside runs can be built so that the yards may be increased in size to accommodate the chicks as they grow larger, or the number of chicks can be reduced. The latter is, perhaps, the easier plan, for then the brooders are all of the same length, but either plan can be used, as desired.

Elsewhere in these pages is shown an illustration of the hot-water heater with pipes attached. If a long brooding-house is built a double heater with pipes extending both ways should be used, for this places the heater midway of the house, thus bringing the source of heat nearer to the pens located in the ends of the house farthest from the heater. Where a short house is built, say one of fifty feet or less in length, a heater with pipes extending from one side only will do very well. If a house one hundred feet long is built, by all means locate the heater in the middle of the house.

A pit should be dug 15 to 18 inches deep for the location of the heater. Make this pit large enough so that the heater can be taken care of conveniently, and the coal pit or bin should be located back of the heater and within easy reach of it. If you are located in a large city where first-class plumbing can be had at a reasonable price, it may be as well for you to buy piping near at home and save freight charges, though the freight charges on material of this class are not excessive. We think, as a rule, it is better to buy a heater and piping complete with full directions in the shape of blue prints for setting up, building the brooders and operating the same. Several incubator companies furnish blue prints and full instructions for building and operating both the single row and double row brooding houses. Where their plans are followed, they assume the responsibility of proper fittings, etc., which as a rule more than offsets the freight charges, for they know what they are about in this particular line, while the ordinary plumber may be at fault.

Any good carpenter, by studying the plans shown on page 42 and consulting the accompanying bill of material, can build this single-row brood-house without making a mistake. It is really a simple affair, but should be well and snugly built to preserve the heat and keep out the cold. Brood-houses like the two illustrated herewith are extensively used by the successful duck and broiler raisers of the east.

Bill of material for single row Reliable brood-house No. 4:

4	4x4	16 ft. sills.
2	4x4	12 sills.
9	2x4	7-10 long side.
14	2x4	3-10 short side.
17	2x4	12 ft. rafters.
17	2x4	5 ft. rafters.
5	2x4	7 ft. end studs.
15	1x4	8 ft. collar beams.
6	2x4	6 ft. partition for wire.
5	2x4	16 ft. plates.

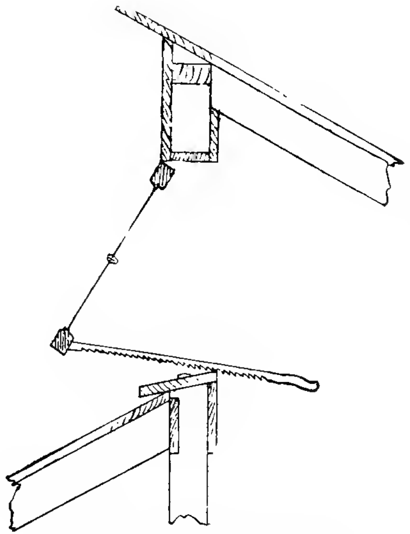
Sixteen posts set in the ground, 560 ft. 8 ft. wide matched, 618 ft. 12 ft. wide matched, 160 ft 12 in. stock for casing, 650 ft. sheeting, 5,250 shingles, 6 windows, sash 2 ft. 6 in. wide, 32 in. high, 84 ft. stock for pens, 212 ft. 12 in. stock for brooder, 32 ft. 6 in. dressed fence for ridge boards, 7 pair 4 in. strap hinges, 6 pair spring hinges for chicken doors, 25 lbs. 20 spikes, 50 lbs. 8 common nails, 24 lbs. 4-penny nails, 10 lbs. 8 finish, 1 gross No. 7, 1¼ screws for doors on brooders, 2 lbs wrought nails, 36 lineal ft. wire netting 2 ft. wide, 1,350 ft. paper.

JOHN W. MYERS.

Double Row Reliable Brooding House

DESIGNED BY

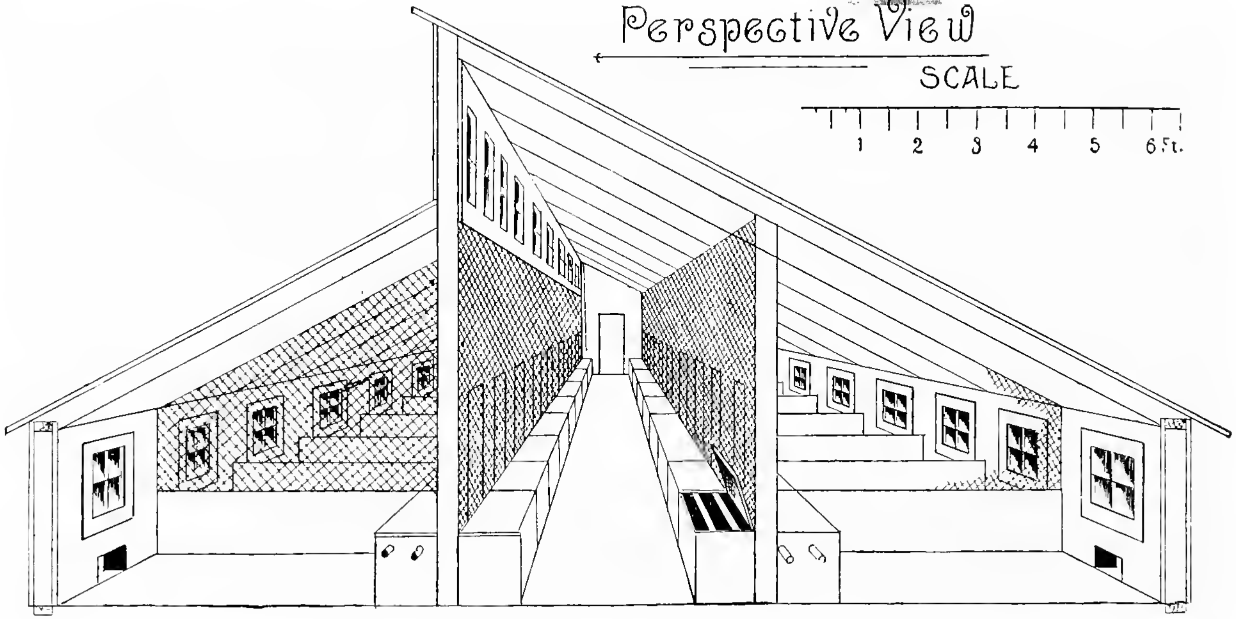
Reliable Incubator & Brooder Co.
Quincy Ill.



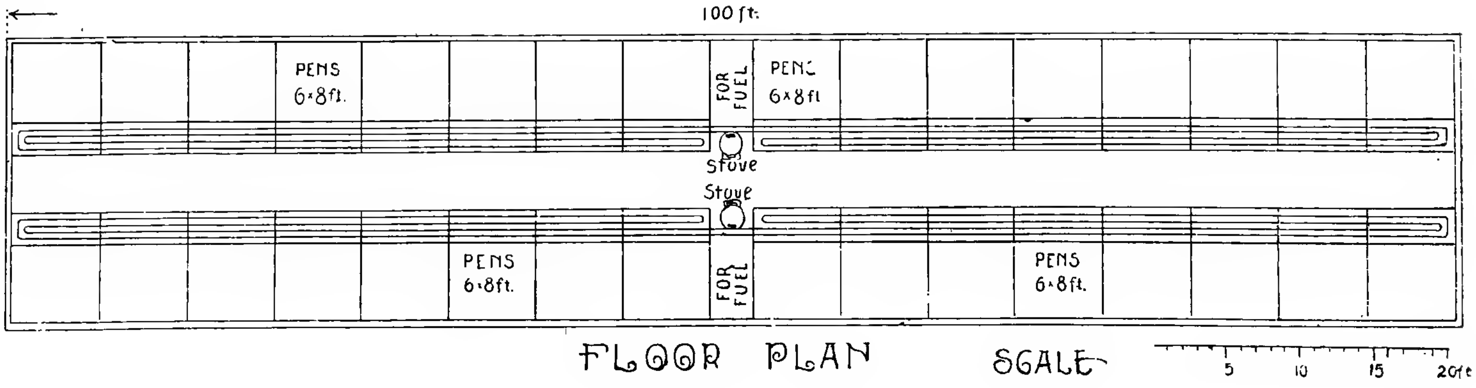
WINDOW AT GABLE TO SWING

Bill of Lumber

15	4 × 4	16 ft Sills
6	4 × 4	12 ·
3	4 × 4	14 · ·
18	2 × 4	10 · Center Stud.
15	2 × 4	12 ·· Side ··
30	2 × 4	16 · Plates & ··
12	2 × 4	14 ·· ··
36	2 × 4	16 · Rafters
36	2 × 4	9 ·· ··



Perspective View



FLOOR PLAN

DOUBLE ROW RELIABLE BROODING HOUSE.

THIS double row Reliable brooding-house, as illustrated and described on opposite page is, we believe, an entirely original production of the Reliable Incubator Company. It combines a number of features found in no other style of brooding-house and has several advantages that make it extra valuable. The row of gable windows fronting south permits the sunlight to fall into the north or rear rows of pens during the winter time when the sun swings low in the heavens, while in the summer time when the sun is high the four-inch casings to these windows cut off every bit of sunlight from the interior. It is in the winter time that sunlight is so essential to the health and comfort of the chicks, and at this season of the year both rows of pens are taken care of in this respect.

By locating the brooders half way in the aisle and half way in the pens, with hinged lid doors opening from the aisle, the chicks can be put into the brooders and the brooders cleaned out without going into the pens. A house built after this style that is 100 feet long, is equivalent to a single row house 200 feet long, but is much more compact, is easier to keep warm and of a uniform temperature. A house of this style that is 100 feet long should have two stoves, one to heat the piping system on each side of the aisle, and these stoves when located mid-way of the building will keep the general temperature moderately warm, in fact, drums can be put on the stoves if desired, or common stove pipe can be conducted the length of the house, one going in one direction, the other in the other direction, thus utilizing practically every bit of heat that comes from the fuel. Two stoves with drums or stove pipes as suggested operated in a house of this style, that is warmly built, will keep the temperature up to 60 or 70 degrees in ordinary weather, and this will give an ideal place for brooder chicks.

The youngest chicks should always be placed in the pens next to the stoves, or nearest to the source of heat, and this will also place them in the warmest part of the building. The south and north walls of this building are to be only three feet or three and a half feet high under the eaves, and should be double, with a four-inch air space between, the outer wall to be lined on the inside with building paper or tarred felt.

The house foundations measure 100x20 feet, inside measurement. This allows a passageway four feet in width, and leaves space for forty pens 5x8 feet, twenty on each side of the aisle. Allowing one hundred chicks to the pen until they are three weeks old, seventy-five to the pen when they are between the ages of three and six weeks, and fifty to a pen after six weeks, or an average of seventy-five to a pen, this house is calculated to accommodate 3,000 chicks.

The foundations consist of 4x6 pieces resting on the tops of 4x4 red cedar posts that are two feet long and sunk into the ground a distance of twenty-two inches on an average—the ground being nearly level. At no point do the 4x6 pieces rest on the soil. The floor of the house is covered with three to four inches of sand and fine, screened creek gravel, and it is this dry gravel and not the surface soil that comes in contact with the sills, thus preventing them from rotting.

Pieces 2x6 are used to support the large roof, the uprights all being of 4x6 stuff. It is hardly necessary to go into such details as these, as any carpenter and builder should know what sort of lumber is required for such a building, so far, at least, as its strength is concerned. The sides of our house are made of No. 2 tongue and grooved lumber, planed on one side. Both roofs should be shingled, the sheeting to be put on first, close together, building paper or tarred felt to be put on over this and then the shingles put on with four inches exposed to the weather, which will insure a warm roof. Of course the building can also be ceiled overhead if desired, leaving a four or six-inch air space, which will make it extra warm. It pays to build a brooding house so as to have it plenty warm. It will save more than enough fuel to pay a handsome interest on the extra investment, and will save in labor and in loss of chicks as long as the house is used.

The windows (forty of them) are all of the same size, 20x40. The house faces to the south. All the windows are hung from the top and are made to open outward, so that if left open during a rain storm the rain will not beat in.

The rear section of this house is four feet wider than the forward section, the four-foot passageway being entirely under the rear roof. The supports of the point of the roof of the rear section extend down to the ground and form part of the partition dividing the passageway and the front tier of pens.

The rear wall or back of the house is only three feet high, the extreme height of the rear section being eleven feet. This gives the big roof a good pitch. The front section is forty-two inches high at the eaves and seven feet six inches high where it joins the rear section. This roof is a little too flat for the good of the shingles.

Board and wire partitions are used, two twelve-inch boards being placed at the bottom and two-inch wire mesh above. Doors open from the hallway into each pen. The attendants and visitors are required to step over a twelve-inch board in going in and out of the pens, the other twelve-inch piece being made a part of the door. Every door is supplied with a spring so that it does not fail to close after the large percentage of visitors who, as the saying goes, "must have been raised in a barn," as they seldom close a door behind them.

In our opinion, here is the best style of brooder house for raising broilers that has been designed thus far. If a man cannot raise chicks successfully in a brooder house of this kind, the chances are about ninety-nine to one that he is not qualified to raise them anywhere in any way. The bill of lumber for this house is presented herewith, and any good carpenter can build it.

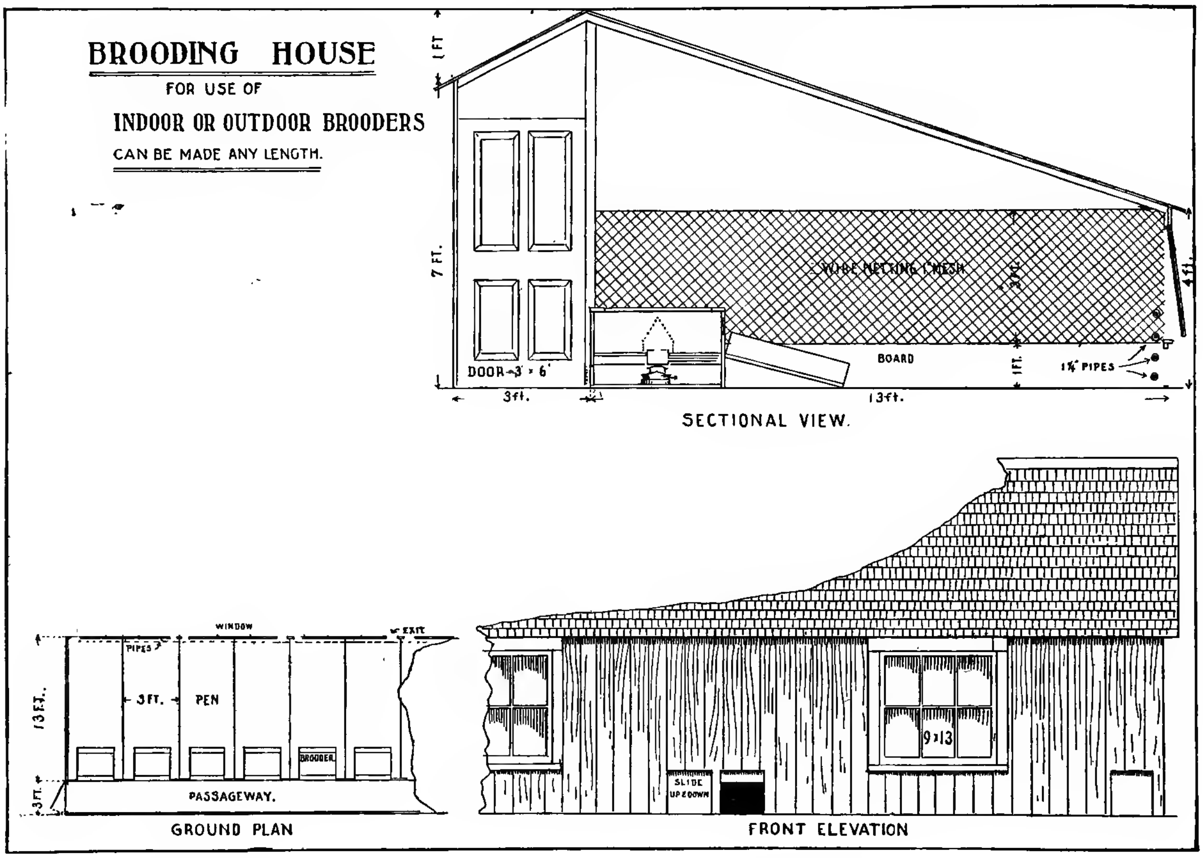
Bill of material for Reliable Double Row Brooder House No. 3:

15	4x4	16 sills.
6	4x4	12 sills.
3	4x4	14 sills.
18	2x4	10 center studding.
15	2x4	12 side sills.
30	2x4	16 studs and plates.
12	2x4	14 studs.
36	2x4	16 ft. rafters.
36	2x4	9 ft. rafters.

2,100 ft. 12 in. stock for brooder and casing, 2,600 ft. wide matched, 2,400 ft. sheeting, 20,000 shingles, 48 windows 12x14, 4 lights, 48 pairs 2 in. butts, 3 gross ¾ No. 6 screws, 150 lbs. 8 common nails, 50 lbs. 20 spikes, 10 lbs. 8 finish nails, 4 pairs 4 in. strap hinges, 32 pairs spring hinges, 3,700 ft. paper, 240 lineal feet wire netting 2 ft. wide, 200 lineal ft. wire netting 6 ft. wide.

DESCRIPTION OF HOUSE FOR INDOOR BROODERS.

Numerous experienced poultry raisers use separate indoor brooders in brooding houses for taking care of the chicks during the first six or eight weeks of their lives. They like these separate brooders better than the continuous-pipe system. Any style of brooder may be used in a brooding house like the one shown in the accompanying illustration. Of course the brooders should be built on correct principles and be equal to the requirements. Avoid cheap, flimsy goods at one extreme and fancy or complicated, high priced goods at the other extreme. Generally speaking, medium priced goods can be relied on and it is common experience that the simpler a brooder is, the better.



The house shown herewith can be of any length and the other dimensions can be varied to suit. Those given in the drawings are recommended, however, as being satisfactory. The style and size of brooder you use will govern the width of the pens, but there is no limit to the length of them, except the ground available and the depth of your pocketbook. A house 16 feet wide, as shown in the diagram, should be about right. A shed roof that is more than thirteen feet wide will need substantial bracing along the middle.

A house of this kind should be warmed by two outgo and two return pipes, extending along what may be called the front of the house, i. e., where the windows are located. See sectional view herewith. One and one-fourth-inch pipes are sufficient, as a general rule. These pipes will moderate the temperature of the house, and the chicks, when they need greater warmth, will stay in the brooders, or run back and forth.

The wire netting used should be of one inch mesh, as chicks readily go through the ordinary two inch mesh. Be sure that the floor is dry. We earnestly recommend a substantial shingle roof. Dampness is the arch enemy of chickenhood. The three essentials to raising chicks by artificial means are, dry quarters, ample warmth and cleanliness—the word "cleanliness" including clean quarters, clean, wholesome food, and fresh, pure water.—Ed.

BREEDING STOCK—INCUBATING—CHICKS.

Care of Breeding Stock to Obtain Fertile Eggs—The Incubator Is Not a Mystery, but a Practical Success—How to Brood the Chicks—What to Feed.

BY E. O. ROESSLE,
Formerly Editor Poultry Department Country Gentleman.

THE modern and up-to-date methods of raising chickens so far surpass the old fashioned ideas that we can safely say that they have become a science. This term seems to fit poultry culture to a nicety, because science is really knowledge reduced to system. Haphazard chicken raising is a thing of the past and with the progress going on in this particular branch of farming at the present day I hope it will never lapse again into any method where chance will form any part of it.

To obtain the knowledge necessary to successfully carry on a poultry plant requires an apprenticeship which is gained by some years of hard study of the subject, not from books alone, as in most sciences, but from practical work based on one's own experience.

What has brought the mind of the average poultryman (who, by the way, was originally a plain farmer), to make poultry culture a science, is undoubtedly the introduction of the modern improved incubator. I assert, without fear of contradiction, that artificial hatching has done more to improve poultry and to increase the industry to its present proportions than any other one thing. The incubator has brought us in intimate relations, first with the germ in the egg. Before the introduction of the simple little testing lamps, the germ in the egg was something never thought of. If we stop to reflect on the early days of our youth on the farm, we remember that all we knew of hatching eggs was the very primitive fact that "mother" put thirteen eggs under the hen and the chickens came out in due time. We knew nothing of the why or the wherefore of the process. It was very much like the kodak, "You press the button, we do the rest."

Mr. E. O. Roessle.

The result of this primitive process of feeding and raising chickens was the survival of the fittest. But primitive though it may have been, it has laid the foundation for many sound teachings in modern poultry culture. It has proved one thing beyond a doubt, and that is that newly-hatched chicks are not delicate because of their age and size, but on the contrary are quite strong and hardy; and it is only a lack of knowledge of this fact which causes the inexperienced amateur of to-day to coddle them, so that their lives are prematurely shortened and few grow up to become fowls.

The American mind is not, as a usual thing, satisfied to accept things blindly. We are too inquisitive to let matters rest without knowing the inside of them. Some, even to-day, may ask how much better off are we now for knowing anything about the germ in the eggs? If we have received no other advantage we have been able to determine the vigor and health of our breeding stock from testing an egg. This one point is the forerunner of successful incubation, whether it be done naturally or artificially.

It may sound absurd to breeders, but I will venture to say that six men out of ten one meets on the street are ignorant that it requires a rooster mated to hens to produce fertile eggs. In other words, the prevailing opinion seems to be that any egg will hatch. We have learned from artificial incubation what a mistake this is, Every egg will not hatch and it may as well be understood at the beginning that only those eggs which come from good, sound, strong stock carefully mated, will hatch at all, and that the stronger the original stock the stronger and healthier will be the chickens.

THE BREEDING STOCK.

To keep breeding stock in the condition to produce hatchable eggs requires good common sense and good care. In the first place the stock must above all things be healthy. Stock out of condition when mated, or allowed to become so later, will not lay many eggs, and even these will show a small percentage of fertile ones. To keep stock healthy depends entirely upon the care and feeding. It is my opinion that the average breeder feeds too much. The result of this is overfat stock and poor eggs. Fat hens will not lay fertile eggs, and over-fat roosters are not vigorous.

Good judgment in feeding is based on a study of nature. For example, a hen's instinct is to hunt for her food. If we wish to follow nature, therefore, we must endeavor to assist this instinct. If we feed a morning mash we must feed only enough to tone up the system ofter a night's fast, and allow the instinct of hunting for more to prevail in the hen. If the flock is cooped in winter, by scattering grain in deep litter in pen or scratching shed we give them something to find when hunting, which simply encourages them to hunt for more. If the flock is yarded in spring and summer we must scatter grain so widely in the runs that the hunting process still continues, induced as before mentioned by a short morning feed. At night a liberal feed, entirely of grain, is necessary, governed as to quantity by what each flock will eat up clean. This liberal feeding at night fills the crop and helps to keep the fowls comfortable and contented till morning, and it has a great deal to do with the production of the next day's eggs.

Variety in food must not be overlooked. Here again instinct must be followed. The hen that roams at large helps herself to every variety of food which she can possibly find. And yet with all the care and judgment in feeding, if we forget to induce exercise we will ruin our chances and the fertility of our eggs will be as small as ever.

THE IDEAL MATING.

The busy female and the gallant male make the ideal breeding pair. The former will be a hustler for food from morning to night with an occasional rest for pluming and dusting, and the latter will be almost constantly attractive to his mate, scratching, calling and offering tempting morsels. Such a combination cannot fail to produce fertile eggs.

A tendency exists among our more advanced breeders of the present day towards small matings. This has come about from experience and has in many cases decidedly increased the percentage of fertility. The old method of allowing any number of males to run at large with any number of females had but one advantage, it tended to small matings; in other words, there were always enough males. A well mated pen should never contain more females than the male bird can do full justice to. The exact number can be decided on according to the breeds. Whereas eight or ten females are sufficient for one male in Plymouth Rocks, a White or Brown Leghorn could do equal justice to a dozen or fifteen females. Extremely small matings, such as trios, I consider have their disadvantages, principally in a waste of vigor in the male bird.

The age of breeding stock frequently controls fertility. Old hens, unless they are very exceptional, are poor breeders. They are inclined to fat and become lazy by nature. If I were selecting an ideal pen, I should confine yearling hens with cockerels, or fully developed pullets with very vigorous yearling males. My remarks are nothing new probably to breeders of experience; in fact, we all who are at all successful have learned the secrets of strong fertility, but can our farmer friends be induced to take a lesson and profit by what the advanced breeders are doing?

HATCHING WITH AN INCUBATOR.

The science of poultry culture need not frighten any one who has never considered raising chickens any great thing to do. I grant that the old way, with a sitting hen, has always proved good enough for him, but when, as at present, the opportunity is at hand to make dollars where he made dimes before, it would seem that he should take advantage of it.

The farmer's wife is the best person on the farm to run an incubator. In the first place she stays more at home than the farmer, and is more particular about the details of the house. Secondly, she is decidedly more patient, careful and persevering. These qualities fit her nicely for incubator work. I know well that the first objection to this loading more on the usually overworked housewife of the average farm will be that she has too much to do now without bothering with any such nonsense. Running an incubator on a farm is not the bugbear one imagines, and it is not nonsense. It is a very simple operation and will return to the farmer's wife a good profit on the time and work she devotes to it.

On the up-to-date poultry plant an incubator cellar is a requisite, just as much as an incubator. A cellar is the very best place to set up a machine, because, above all things, the variations of temperature are slight and it is usually dry. There have been hundreds of failures in artificial incubation on farms, from the very fact that the machines have been placed in barns, sheds, or any old building above ground, where a space could be found. The result of this has been so great a degree of fluctuation in the temperature (eighty or ninety at noon and forty or fifty at night), that no machine made could help being affected by it. The first principle of hatching an egg is uniformity of heat. This should be known by any farmer's wife and certainly is not mystical or scientific. She knows it when she sets her hen, and she takes pains to see that "Biddy" sticks to her nest.

I really believe that the objection to incubators on farms, as a usual thing, is based on a certain mystery supposed to be connected with them. When questions such as "How long does it take to hatch chickens in that box?" are asked, it seems to prove my theory of mystery. The average farmer seems to forget that the incubator, although artificial, is still a copy of the natural process of incubation by the hen. Nearly every farm, whether it be run on plain or scientific principles, has a cellar. Potatoes, apples, roots, turnips pumpkins and a variety of other things to be kept over winter must be put in a cellar, and such cellar must be dry. Every farmer's home even has a cellar, and this is also usually dry. Now we must find a space for at least one hatching machine in this cellar. Of course the house cellar will be the most convenient for the farmer's wife, especially in bad weather when she might have to tramp out to the potato cellar to fill the lamps or turn the eggs.

RUNNING AN INCUBATOR.

We have found the place for an incubator, now let us explain the machine. In the first place, it is not a bother to run one, nor is it at all difficult. The farmer's wife may go to bed just the same; she need not sit up with the machine. It will keep on all night attending to business, and she will visit it in the morning and find it all right. When the machine arrives from the factory it must be set up. It will be nicely packed and all its "fixings" will be found inside, securely fastened. Fit these by the book of instructions to their places and then take a spirit-level and be sure the machine is level on all four sides. Next fill the lamp and place it lighted on the stand, where it belongs. Having placed the thermometer inside on the tray, watch it and see the mercury rise until it reaches 103 degrees. It will be noticed that a little delicately adjusted disc on top is open above the lamp chimney. This is the regulator for the heat and must be kept closed until the thermometer registers 103 degrees. Then if it lifts a little and rests so, the mercury will remain where it is. When this much has been done, let the machine alone until morning and then see what the thermometer says. If it is still found to register 103 degrees, the object is accomplished. Now is this difficult? Is there any thing terribly scientific about it? And yet you have succeeded in regulating that very mysterious invention, a hatching machine. By regulating I mean you can be satisfied that you know how to control the heat inside the machine. This is more than half the battle.

The eggs may now be introduced and after they have been in long enough the mercury in the thermometer will return to its original mark and rest at 103 degrees, which is correct.

The daily care of a hatch consists in turning the eggs twice a day, morning and night, and filling and trimming the lamp. This very easy task continues for seven days. On the seventh day the testing takes place. This is quite simple and is done by passing each egg in front of the testing lamp (which is provided with the machine) and discovering the germ. This germ consists of a black spot with spider-like legs radiating from it. The stronger this appears the stronger will be the chicken. Eggs which are clear and contain no spot are infertile or dead and should be thrown out. They will never hatch. After the test there will be fewer eggs left in the machine, but each egg will contain a possible chicken. As this means life each egg will radiate more heat itself. This will necessitate a readjusting of the regulator. 103 degrees should be continued constantly day and night until the chicks are hatched.

The guide which is most reliable in determining the progress of the hatch is the development of the air cell. This is a little space in the large end of the egg which is visible at testing time and should continue to grow larger and larger until about the nineteenth or twentieth day, when it occupies about one-fifth of the entire egg. Unless this air cell is developed correctly by the twentieth day the chick cannot turn itself in the shell, hence sticks and dies although it may be fully developed. The development of this air cell is the vital point to be considered in obtaining a first-class hatch. It is controlled in two ways. If it develops slowly, which is usually the case, give the machine and eggs all the air you can. This can be done by opening the slides over the ventilators full width and cooling the eggs as long as possible each day. The cooling process is best accomplished by placing the trays of eggs on top of the machine (closing the doors meanwhile), and leaving them there until the thermometer drops to 80 degrees, not lower. As the hatch progresses the eggs will stand more and more cooling.

If the air cell develops too rapidly it can be checked by almost closing the slides (but never close entirely) and introducing a very little hot water in the moisture pans. This checking development is rarely necessary, as almost any cellar contains a sufficient amount of natural moisture to check a too rapid development. Hence the moisture question is one hardly to be considered except in extreme cases. The chances are that the difficulty will be in enlarging the air cell sufficiently. When the chicks begin to pip the shells keep the doors of the machine closed until the last chick is hatched. Close the ventilating slides almost entirely and keep the thermometer up to 103 degrees full.

This is a brief description of hatching chickens artificially, and I have tried to make it as clear as possible. When the last chick is hatched keep all the chicks in the machine thirty-six hours before placing them in the brooder. This I consider one of the most important points in raising strong chickens. It gives them a good chance to digest the yolk of the egg, which is their natural first meal, and broods them sufficiently after leaving the shell, to make them strong on their legs. Chickens which are strong when introduced into the brooder usually live; the weak ones die.

BROODING CHICKS ARTIFICIALLY.

With a hatching machine you must have a brooder. Every first-class hatcher has a brooder suitable for the machine. Brooding chickens successfully is in my opinion a difficult task. This is true particularly because the correct principles are not understood. A brooder whether indoor or out, should be capable of radiating heat uniformly. Chickens require a hover or heat section where they can find the heat when they feel chilly. They do not do well in any brooder which is half heated or all heated. The hover alone should contain the heat and the rest of the brooder be cold. This is especially true of indoor brooders. The cool place of an out-door brooder should be outdoors itself. Cuddled chicks or those that live in an atmosphere poisoned by heat, sicken and die. The hen is the hover or heat and all the rest of this natural brooder is cool or cold, in fact is outdoors itself.

The feeding of young chicks bothers many persons and causes a large percentage of mortality. For two or three days a good food is, first day, rolled oats every two hours or when the chicks appear hungry. Then for two days use any first-class chick meal. To this mash should be added a liberal handful of chick size grit and well mixed in it. This will be the greatest aid to digestion and will prevent in a great degree, if not entirely, bowel trouble, the most prevalent ailment of artificially brooded chicks. After two days whole wheat and small sized or sifted cracked corn may be given two or three times daily, after feeding the morning mash. Green food also, in the shape of small cabbage, may be given every day after the third day.

Water should be kept by them constantly from the minute they are placed in the brooder. It should be clean and kept so, and at the temperature of the house and not of the hover.

The heat in the hover should be reduced as rapidly as possible after the first week, the degree of heat to be determined by the chicks themselves. If they crowd at night they need more heat; if they sleep well separated they are all right. Too much heat for too long a time will do them as much harm as overfeeding. As chicks start out in life, strong, robust and active, we must try to keep them so and make them as hardy as possible.

Exercise is absolutely necessary in order to raise healthy chickens. They can not exercise too much; in fact they should be kept busy from morning until night. They will seek the hover when they feel the need of heat, and will or should continue to scratch the rest of the time. Always give them something to scratch for. Scatter small grains in deep litter in doors, or scatter it in their outdoor runs. If they hunt and scratch and find something they will be encouraged to hunt again.

The worst ailment which we must fight is what is known as bowel trouble. Over-feeding and bowel trouble will reduce the percentage of your brooder chicks so alarmingly that the bravest and most enthusiastic amateur will give up the artificial method, utterly discouraged. Bowel trouble comes from indigestion and is easily controlled and cured by mixing plenty of grit in the soft mash or food other than grain. Mixed in the food the chicks are compelled to eat it, and thus the proper substance is supplied to their small gizzards, which grind up the food.

Fresh air never killed any chicken. Therefore give them access to it freely, provided they have learned the way back to the hover. To sum up and make the brooding question short, follow as nearly as possible the actions of the hen when she cares for her brood and you will raise strong chickens artificially.

A warm, not hot hover, and a cool house.

Feed only when the chicks are hungry and thus never overfeed.

Put plenty of grit in the food, compelling them to eat all together, thus insuring good digestion.

Keep them exercising and give them plenty of fresh air. By following these few rules your chickens can not help being healthy.

CONCLUSION.

What advantages are gained by raising chickens artificially, is a question frequently asked by those who have never tried the experiment. Artificially hatched chickens are just as strong as those hatched by natural process. The percentage is larger with the machine. The trouble is slightly more and the anxiety decidedly less. From two to five hundred chickens can be hatched with very little expense and very little trouble. The machine is always ready for business and one does not have to wait for a broody hen; hence chickens can be hatched far earlier. It all depends upon the percentage of fertility of the eggs. Fertile eggs are absolutely necessary to insure a large percentage of chicks at any time of the year. Incubated chickens do not have lice, gapes and many other kindred ailments. Brooding can be successfully accomplished if the suggestions I have made are carefully followed. An incubator will be found a very valuable acquisition to any farm, and many of them to-day have paid off old and troublesome mortgages.

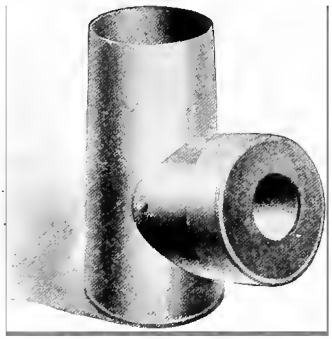
Where there is room for one machine in the regular potato or root cellar of any farm, space can easily be had for more machines. As one machine makes a return which will, without doubt, be satisfactory, another can be added until a fine poultry plant is established. It is a poor machine which, if properly run, cannot pay for itself in one season. Where there is one chicken hatched to-day by the hen there are hundreds of them hatched by machines.

With the great boom in chicken raising by artificial means sweeping all over the country, it is time that our farmers realized that the old-fashioned method is played out and that the modern incubator and brooder are the successors of Mother Hen.

TESTING EGGS FOR HATCHING.

AS SET forth elsewhere in this book, have your eggs as uniformly fresh as you can get them and reject all that are overly large or undersized; also, all ill-shaped ones, including those with ridges around them or uneven ends, and all with thin or mottled shells. You can discover the mottled shells by holding the eggs between your eye and a lighted lamp, but it is better to use the lamp egg-tester. Use it in a dark room and you will have no trouble in detecting the mottled shells. Eggs with mottled shells sometimes hatch, but not as a rule. The shells of these eggs are so much thinner than the average shell that the evaporation of moisture within the egg is too great by comparison and the chick dies by drying up.

The three kinds of egg-testers in common use are illustrated herewith. The first, a lamp egg-tester, is made of tin and fits on the ordinary lamp in place of the glass chimney. Where the lamp tester is used the work should be done in a dark room, there being no other light than that furnished by the lamp. This light is confined by the metal chimney, except that which shows through the opening that is filled by the egg when in position. The egg should fit snugly in the opening, so that practically no light will show around the sides of the egg. By this means you can see easily whether the egg is perfectly clear, whether it shows a stale spot, or whether it is strongly fertilized, showing the chick embryo with the veins of blood radiating in different directions.



Practical Egg Tester.

The Practical egg tester shown herewith is the standard one in use on large duck and broiler farms and it embodies the best ideas to date. This tester is eighteen inches high, ten inches wide and ten inches deep. The top is galvanized iron. It is equipped with an extra strong reflector of superior quality. The lamp is made of the best blocked tin, the seams being machine turned and carefully soldered and tested for leaks. An ordinary glass chimney such as is used on a house lamp will fit the burner and is best for the purpose required. In testing, the lamp is lighted and placed inside the tester in such a position that the broad surface of the flame is on a line with the reflector, which is hung in the opening at the back of the box. This concentrates the rays of the light in the testing tube located on the opposite side of the box. The eggs are held against a hole in the cloth end of the testing tube. The strong light penetrates the shell and brings to view the development of the contents of the egg, making it possible to discover the degree of fertility, or the growth of the embryo. To get the best results this tester should be used in a dark room. There is nothing about it to get out of order or wear out.

A window egg-tester is built of common boards so as to fit into a south, east or west window, and should be painted black on the inside or covered with black cloth. Surround the openings into which the eggs fit with leather and cut an opening for the egg of such shape that the egg, when pressed against the leather, will completely fill the opening. If you have an east window, make a practice of testing your eggs in the morning, on a sunshiny day. If a west window, wait till afternoon, the object being to have the sun opposite you, so that you will look through the egg at the intense sunlight. Using such a tester in the way advised you can see very clearly the contents of the egg and will soon be able to tell just what the egg is worth. Two persons can work at this tester, and in cold weather it is often advisable to test the eggs as rapidly as possible so as not to cool them down too much while they are out of the machine.

The three cuts of eggs shown herewith illustrate the appearance of eggs usually found in testing a lot that have been in an incubator. Fig. 1 shows a strong, well-fertilized egg as it appears on the sixth, seventh or eighth day. Fig. 2 shows a weak or imperfectly fertilized egg, one that will not hatch. Fig. 3 shows a stale egg, one that has become too old, the yolk having settled to one side of the egg. An infertile egg shows perfectly clear when looked at through an egg tester. There is no appearance of a germ, either strong or weak, or of a stale spot. It is of one uniform color, and should, of course, be rejected.

Test the eggs in the machine on the seventh or eighth day and again on the eleventh or twelfth day. There is no hard and fast rule as to the best days on which to test eggs. Expert breeders often test as early as the fifth day, for they can tell by that time whether an egg it hatchable or not, and they want room for other eggs, as they make a practice of setting two or more incubators on the same day and then shifting the eggs forward from one incubator to another, replacing the infertile eggs, thus gaining room and being able to reset the incubator or incubators that are emptied in this manner. With beginners, it is better, no doubt, to wait until the seventh or eighth day, for by this time even a novice can tell, by consulting the eggs shown on this page, whether an egg will hatch or not. If in doubt, replace the egg in the machine and wait for the second test.

A number of eggs will appear to be all right from the fifth to the eighth days, the chicks being alive and giving promise of coming out all right, but they will die between this time and the fourteenth day, for there will be found in every incubator full of eggs a number that are fertile, but which will not stand incubation, the germ not being strong enough to develop during the three weeks into a full grown and vigorous chick. After some practice many of these eggs can be detected at the second test and should be rejected. Experience is the only safe teacher in matters of this kind, and each operator of an incubator will have to investigate matters for himself. The writer has broken dozens of eggs, "as a matter of curiosity," thus settling doubts as to particular eggs. There is no other way. It is a good idea to mark all doubtful eggs you replace in the machine, so that you will look at them closely when you come to the second test. Eggs should not be tested in an atmosphere that is colder than 65 degrees, if it can be avoided. Do not under any circumstances test eggs in a freezing atmosphere. If necessary, cover the egg-tray carefully with a warm blanket and carry the eggs to a room that is warm.

USE OF THERMOMETERS IN INCUBATORS.

BY CHARLES WILDER, MANUFACTURER.

THE right use of heat in incubators is the key to success. All other conditions may be perfect, but, if the heat is wrong, the hatch is a failure. To get and keep the right degree of heat a measure of heat must be had. The measure must be accurate, constant, simple, easily used. That measure is the thermometer. Thermometers do not create, change, modify, or control heat. They simply register heat, rising and falling as the heat changes, telling at once each change with precision. There need be no difficulty in getting thermometers that are accurate and will remain so.

To be simple, so that people not experts can use them easily, thermometers should be adjusted correctly, and have no adjustments or attachments except those sent with incubators. The form of an incubator thermometer is not essential, nor is the material from which thermometer scales are made essential. Some of the first incubator thermometers used in this country were made in Germany, where—on account of its cheapness—wood, instead of metal, was used for the scales. These were quickly superceded by the much more accurate and nicely made American thermometers. But there is still among a few operators of incubators a vague idea that somehow a wood back is better for an incubator thermometer than a metal back. There is no good ground for this. The writer made thermometers for over thirty-eight years, had a personal acquaintance with over fifty manufacturers of incubators, and had been to their factories, some of them several times—had studied the construction of their incubators, methods of application, diffusion, regulation and circulation of heat, their ventilation, use of moisture, and methods of using thermometers, and was fully satisfied that there was never an egg that could be hatched artificially by the use of a wood scale thermometer that would not hatch equally well by the use of a white scale metal thermometer under any possible conditions. After making incubator thermometers with scales of wood, tin, zinc, bronze and brass, finishing natural color, black and silvered, his conclusion, based on a life-long experience, was that the most legible, accurate, practical incubator thermometer is one with a white metal scale. But the color of a thermometer scale may affect its action. As black absorbs heat much more readily than white, we regard black scale thermometers as unsafe to use in incubators.

Mr. Charles Wilder.

LOCATION OF THERMOMETER.

The position of the thermometer in incubator—whether it stands up, lies down, or lies inclining, does not sensibly change its action, if the thermometer is properly made. The location of thermometer—where but one is used in an incubator—should be as near the center of the egg tray as it can be and be seen from the front. Where two thermometers are used in one tray, place them a few inches from each Of course location of thermometer must also depend on the end of the tray, as far back as they can be easily read. construction of the incubator.

Formerly in using thermometers in incubators it was the general practice to have the bulb touch the egg. For several years the writer advocated using thermometers in incubators without touching the egg. Several makers of incubators have already adopted this practice, and we predict that it will be the general practice. This conclusion is based on the following reasons:

First—The well known difference in heat during incubation, between a fertile and an infertile egg.

Second—An egg may be "alive" when thermometer bulb is placed against it, and a "dead" egg a few hours later and before changing position of thermometer. As the dead egg cools, to maintain its heat at 103 degrees the heat of egg-chamber must be raised, so that a large number of live eggs may temporarily be subjected to excess of heat, because of the cooling of thermometer by a dead egg. While this might not prove destructive, it would have that tendency. Evidently the true method in incubation lies in eliminating, so far as we can, possibilities of failure, rather than in taking all doubtful chances of success.

Third—The difference in heat of the same egg at different stages of incubation is well known. While this is sought to be provided for by change of heat in the later stages of incubation, the fact that incubation does not progress uniformly in all eggs makes this increase of heat to some degree a factor in the case, as the most rapid evolution of heat in the egg occurs at the time the embryo is quickened, and there may be a difference of one day the time of quickening different eggs, and so a marked difference in heat.

Fourth—There is a decided difference in heat of eggs at the same stage of incubation owing to difference of vitality. To subject an egg of strong vitality to the heat of an egg of weak vitality—or the reverse—during entire period of incubation, might destroy one of them. As, in practice, this does not occur where position of thermometer is changed daily, what does, or may occur, is, that one day the machine is run by an egg of low heat, the next day by an egg with a high heat, so that really instead of a uniform heat day by day, the heat of the egg-chamber may vary several degrees one day with another, when presumed to have a uniform heat. This conclusion, of course, assumes that the thermometer with the bulb in contact with the egg records the heat of the egg it touches, which is the theory upon which the thermometer is used in that position. If it is claimed that the reading of thermometers is not controlled, only modified, by having bulb in contact with the egg, then the argument for having bulb touch the egg loses its force.

Fifth—If it be true that the egg, after the quickening takes place in incubation, observes the law of other animal life, of a daily ebb and flow of heat, that may be given weight so far as it bears on the egg case. This is not offered in evidence, only a suggestion.

From above premises we deduce these conclusions:

First—In artificial incubation the end to be sought is to establish and maintain that degree of heat which will hatch the largest number of eggs under the diverse conditions which those eggs will develop during incubation.

Second—In the nature of the case the exact conditions to be observed to attain this result can not be predicted with certainty, owing to the fact that the vital energy contained in the egg is not now apparent, but is to be developed by the conditions we are to establish to develop that vital energy.

Third—Because of the diverse conditions which develop in eggs during incubation, no fixed law can be made that will produce results with equal certainty. So acting upon the law of averages of results experimentally obtained, practice and experience have shown that in artificial incubation a heat of 103 degrees in general varying according to period of incubation, will give the best average results.

Fourth—It follows naturally that success in artificial incubation is not best attained by bringing one egg to 103 degrees and keeping several hundred other eggs of different degrees of vitality to the heat of that egg, for the whole period of incubation; nor by applying thermometer each day to a different egg, so that there will be twenty different standards of heat during one incubation, but, rather, by maintaining an equal diffusion of heat at 103 degrees in the egg-chamber by a thermometer with a free exposure of the bulb, and allowing individual eggs to maintain such degree of heat as their varying vitality develops. The eggs will then be found to vary several degrees in heat with a uniform heat in the egg-chamber.

To try to bring one hundred or five hundred embryo chickens of different vital conditions to the heat of an individual chicken is contrary to nature. If in hatching one chicken develops 106 degrees and another one but 100 degrees to place a thermometer on the 100-degree chicken and try to make the 106-degree chicken hatch at 100 degrees he might not hatch at all. The same failure would result to place thermometer on 106-degree chicken and try to make 100-degree chicken hatch at 106 degrees. But place both eggs in a tray where the heat is 103 degrees and both may hatch.

In this, as in other things, it is not ours to say that natural law should be changed to meet results we wish to attain, but it is our duty to so conform our methods to the operation of natural law that we shall not fail of success by attempts to change the physical forces.

ACCURACY OF THERMOMETERS.

Of course, if thermometer is not accurate, it will not show good results in the hatch. It is so easy when, for any reason, the hatch fails, to lay failure on the thermometer, that this is often done without reason. Incubator makers know so well the need for good thermometers that, with very few exceptions, they are careful to get the best thermometers that can be had, so that in buying any standard make of incubator purchasers can feel sure of getting good thermometers, and that they need have no care about any "tests" or "adjustments," because their thermometers have already been tested and adjusted better than any one can do it outside of a thermometer factory.

As, in the nature of the case, an incubator thermometer must have a fine mercury column, that column is liable to become divided by a sudden jar, in falling, or by mail transportation. This is in no way a defect. When the mercury column gets divided, a few quick jerks with thermometer held bulb end down, will usually unite it. If this does not do it, tie a stout string to top of thermometer and swing it quickly round a few times. If this fails to unite the column, the thermometer is probably cracked. When the mercury column all rises on top of tube and remains there, the bulb is cracked and thermometer is useless. Each thermometer is an individual, each tube is made and tested, and then the scale is made to fit that tube, so broken incubator thermometers have no value to repair.

Constantly, promptly, accurately the little instrument does its work, often rousing the ire of the operator because it tells just the heat that exists, and not the heat the operator thinks ought to exist, evoking censure because of its truth.

EFFECT OF VENTILATION AND MOISTURE.

The apparent heat of the incubator and its actual heat are sometimes quite different. This puzzles many operators, and is usually the result of errors in operating. The cause may usually be found in defective or excessive ventilation. Where an incubator is given excessive draft, it must have an excess of heat to supply the waste of heat. It will also have an unequal distribution of heat, and the varying currents of air will cause the thermometer to act in an eccentric way. If in a dry place the excessive ventilation will tend to evaporate the natural moisture of the egg, and water must be supplied to furnish moisture. Rapid evaporation will be induced, and (especially if the draft be then partly closed) moisture will collect on bulb of thermometer, and as this moisture evaporates from thermometer bulb it lowers the reading of thermometer, so that while the heat of the egg-chamber is too high, the thermometer registers too low from being made a hygrometer for the time by the excess of moisture induced by the unnatural conditions under which it acts. A similar result might be produced by placing the incubator in a damp cellar when the draft was properly regulated. Thus for the time two opposing conditions exist, both of them harmful to incubation. The thermometer is not in fault, it simply acts in an unnatural manner, because subjected to unnatural conditions. Regulate the draft and moisture properly, and the thermometer will show correct heat, but it can not show heat correctly when forced to act hygromatically, as a wet bulb thermometer.

When two thermometers in different places in an incubator do not agree it is no evidence that thermometers are not accurate, but rather that there is not a uniform diffusion of heat. To show whether thermometers agree in reading, try them in water, with bulbs at the same level in the water, and water stirred to make heat equal.

While artificial incubation has made a great advance in ten years, and has made the poultry product the leading farm product of America, there is yet much to be learned. The needs of the case are to be met in the spirit of the learner who is teachable, rather than by the dogmatism that assumes to know it all. The results of the experience and knowledge of to-day may be modified or wholly changed by the larger knowledge and wider experience of to-morrow.

THE INCUBATOR IN OPERATION.

Getting the Machine in Working Order—Where Best to Locate an Incubator—Location of the Thermometer—Care of an Incubator in Operation.

BY JOHN W. MYERS,
President of the Reliable Incubator and Brooder Co.

IF the incubator you are about to begin work with is one you used last year it will need to be cleaned out, overhauled and put in perfect working order. It ought to have been thoroughly cleaned out when you put it away last summer, but if this was neglected then, do it now. For washing out the egg chamber, egg tray and turning rack, if they were left in a soiled condition or are musty, use hot water into which a liberal amount of baking soda has been mixed. Cleanse and air the egg chamber, tray and rack until they are sweet-smelling.

Next test the regulator. Do this by filling the lamp, lighting it and running the machine two or three days to make sure that everything is in perfect working order. If there shoud appear to be something wrong with the working of the regulator do not trust your own mechanical knowledge to fix it, unless it be some simple matter, but write to the manufacturers, asking them for instructions. Remember, please, that the men who made your machine are really in a position to know more about it than can a person who has simply operated it one or two seasons. It is true that the best of machines have to be run differently under varying conditions, and sometimes the manufacturers' directions have to be departed from in order to obtain the best results, but, nevertheless, in a large majority of cases it is best to follow the directions of the manufacturer of the machine and any departing from these directions should be done cautiously and only after due deliberation, unless you have "eggs to burn,"

Quite often purchasers of incubators report that their first hatch was the best one they ever had. No doubt in a majority of cases this was because they followed closely during their first hatch the directions sent with the machine. Later on they get to thinking that they can improve on the manufacturers' method of operating the machine, and hence gradually depart from their instructions—the results, as a rule, being worse rather than better.

WHERE TO LOCATE AN INCUBATOR.

This question arises with every person who proposes to operate an incubator: "Where is it best for me to locate my machine?" As a rule, taking incubators as they are, a good, dry, well-ventilated cellar is the best place. The air in this cellar should be pure and should be renewed either daily or every other day during the progress of the hatches. Every incubator must supply sufficient fresh air to maintain life in the egg, and this air must be pure if the chick is to come forth strong and healthy. Experts have made tests that proved that the embryo chick must have fresh air almost from the first, and the supply must be kept up until the chick emerges from the shell. Where eggs in these tests were coated with shellac or varnish, not a chick came forth, proving beyond question the necessity of fresh, vitalizing air. A damp, mouldy, foul-smelling cellar is not a fit place for artificial incubation; in fact, it is about as bad a place as one could select. It is a mistake to operate an incubator in an atmosphere that is unfit in any way for human beings to breathe.

A cave that is properly ventilated is also a good place. The main advantage in using a cellar or cave is, that the temperature therein is far more uniform than is the rule in a dwelling house or out-house of any kind. Some incubators can stand quite extreme changes of weather, while others can not. It is better to be on the safe side rather than to depend on the construction of the machine and the regulator to withstand these sudden changes in the weather, where the thermometer may fall 40 degrees within twenty-four or forty-eight hours, as it sometimes does in this latitude.

It has been our experience that where a room in a dwelling house is to be used as the location of an incubator, it is better to select a room in which there is no fire during the day, rather than use one of the living rooms where the temperature is seventy degrees during the day, while the fire is burning, and may go down below the freezing point during the night when the fire is low, or has gone out entirely. In such cases you have, every twenty-four hours, a great change in the temperature of the air surrounding the incubator, and the regulator is put to a severe test. The warm side of a room that is not heated in this manner, or the warm end of a hallway is a better place, in our opinion, than a living room such as is referred to. Where a house is heated by steam or a furnace, or one or more rooms are heated by a base-burner in which a good fire is kept all night, thus keeping the temperature reasonably uniform during day and night, it should be an easy matter to find a satisfactory corner for the incubator. The object is to find a location for the machine where the changes in the temperature of the air surrounding the incubator will be as slight as possible under the circumstances.

No matter what make of machine you have, and no matter where you locate it, it is necessary that you make a study of the machine and of the processes of artificial incubation in order to succeed well—in fact, it is necessary that you should master the subject (and it is not an intricate one) provided you are to obtain the best results possible under given conditions. Hatching with incubators is not a difficult matter where the few essentials are understood, but if these essentials are not mastered, a person is liable to soon come to look upon artificial incubation as an intricate and vexatious problem.

THE QUESTION OF HATCHABLE EGGS.

Now that you have your machine located and everything in good working order, the question of suitable eggs presents itself. Here is one of the important matters to be looked after with great care. We know one man who sent to the corner grocery store and bought 218 eggs from which he hatched 203 chicks, but where this was done in one case, we have heard of dozens of other cases where store eggs did not hatch even three chickens out of 200. It will not do to depend on the store keeper for eggs to hatch. To have to depend upon nearby farmers is bad enough, for they are careless in gathering them, allowing them to get chilled. The person who is in a position to get his eggs for hatching from his own hens, gathering them and caring for them himself, is in a position to know what he is doing. At best it is a hard matter to get satisfactory hatches during December, January and February, for the reason that these months are outside of nature's hatching season, and nature has a way of doing things in her own time, to best advantage: This is not saying that nature cannot be improved on in many cases, or that she cannot be turned from her course and made to serve the interests of mankind, but the fact is, that people who take up artificial hatching and brooding during the three months named have nature to contend against and they will find that she must be studied and courted at every turn. It is a comparatively easy matter to hatch chicks and rear them by artificial means during March, April, May and June, bringing off large hatches and raising a good percentage of the chicks, but in mid-winter the same task calls for greater care and more intelligent management.

Eggs laid during freezing weather, that are to be incubated, should be gathered while they are still warm, or at least before they have a chance to chill, and care should be taken that they do not chill. A good plan is to have a basketful of bran or oats that is kept in a warm room. Take this to the hen-house or barn when you gather the eggs, place the fresh laid eggs in the bran or oats, which will protect them from the severe cold while being carried to the house and until ready for placing in the incubator. Eggs intended for hatching should not be kept in a temperature that goes below 40 degrees, and we would prefer to have these eggs kept in a temperature ranging from 50 to 70 degrees.

When you come to select your eggs for hatching, reject all that have thin shells, rough shells, or that are badly misshapen. The extra large eggs containing double yolks should be rejected and the extra small eggs. Medium small eggs will hatch just as strong chicks as medium large eggs. We have proved this time and again. It saves time and money value to examine the eggs through an egg-tester before placing them in the machine at all. See article on "Testing Eggs for Hatching." Among winter laid eggs, in fact, those laid during any season of the year, you will find a considerable number with mottled shells. These eggs seldom hatch. In testing during the seventh or tenth day, we have rejected hundreds of these eggs, and it is the rare exception that one of them is found to contain a chick embryo, hence it is best to reject them in the first place. By "mottled" is meant a shell that is spotted on account of being uneven in thickness, some places thin and others thick. Such an egg-shell is too thin and porous.

A MATTER OF GREAT IMPORTANCE.

We next call special attention to the importance of the exact location of the bulb of the thermometer you use. In some machines that we have tested a difference of a quarter of an inch in the distance from the bulb of the thermometer to the bottom of the hot water tank or hot-air reservoir (the source of heat) makes a difference of one whole degree in the reading of the thermometer, or, in other words, in the temperature registered by the thermometer.

With some incubators the thermometer is simply laid on top of the eggs. This we consider a poor plan, for the average new hand with an incubator will be careless in handling the thermometer and the bulb may vary from a quarter of an inch to half an inch or more in distance from the source of heat, that is, from the bottom of the tank or hot-air reservoir, the result being a variation of from one to two or more degrees in the actual temperature of the egg chamber, though the thermometer may show the desired 103 degrees. It is far better, we think, to have the thermometer arranged so that when it is placed in position, as per directions, the bulb will always be on the same level and at exactly the same distance from the source of heat; then this thermometer will at all times register the temperature at a given distance from the source of heat, say at a level with the top surface of the eggs, and a uniform temperature may thus be insured at all times, at least so far as the location of the thermometer is concerned.

As a result of our experience, we prefer to have the middle of the bulb of the thermometer on a level with the top surface of the eggs. Note that we say "middle" of the bulb of the thermometer, for this bulb itself is from a quarter to three-eighths of an inch in diameter (some are even larger), and it is worth while to be exact in operating an incubator. Let us be exact, as far as we can, for there will be enough chances against us at best and we want all of the chances we can control to be on our side.

Do not sprinkle the eggs. This lowers the temperature too suddenly and is therefore hurtful. If the machine through some cause runs up too high, dampen a towel or cloth in warm water and spread it out over the eggs in the tray, leaving the tray in the egg-chamber, but not closing the egg-chamber door. Should the heat run up as high as 112 degrees you may still save the hatch by the above plan, providing the excessive heat was not applied too long. At two weeks old the chick embryo will stand more of such abuse than when only one week old, and after the two weeks, handling, jarring, etc., do much less damage than during the first days of the hatch when the chick embryo is first taking form. Be governed accordingly.

FILLING LAMP—TRIMMING WICK.

It is important that you should fill the lamp of your incubator and trim the wick twice a day, morning and evening. The reasons are plain. A steady blaze and an even heat are essential to best results. The wick will not draw so much oil from the lamp that is nearly empty as from one that is half full or nearly full and a charred wick acts as an obstruction to a clear, strong flame, thus diminishing the heat. The lamps ordinarily furnished with good incubators will burn twenty-four to thirty-six hours without refilling (depending upon the height of blaze), but if the operator were to fill these lamps only once every twenty-four hours and should forget to do so some cold night, the oil would give out and jeopardize the hatch. For these reasons it is wise to fill the lamp and trim the wick every twelve hours.

When you first start the incubator use a pair of shears to trim the wick. Have the wick slightly rounding in the middle, to produce an even, or slightly rounding blaze. After this trim the wick by turning it up until the charred part is exposed above the metal jacket, then simply rub a match across the end of the wick, removing the charred part. This is easily done and is all that is necessary.

Where it is convenient to use gas as the source of heat for an incubator it is better than a lamp, for with gas there is a steady supply of fuel as a rule, and no loss of heat results from a charred wick.

FOLLOW DIRECTIONS.

Follow closely the book of instructions sent you by the manufacturer of the incubator you are using. Machines differ in important essentials, and the man, or men, from whom you bought yours should know the requirements of his make of incubator, and this knowledge should be found in the book of directions he sends you. If he does not know how his incubator should be run, he didn't know how to build it in the first place; but if you have a standard machine, then follow carefully what the manufacturer says about operating it.

Sometimes eggs begin to hatch as early as the eighteenth day. In that case the heat in the hatching chamber was too high. They should not begin to hatch earlier than the evening of the twentieth day, and the night of this day is better still. In hatching eggs and raising chicks by artificial means be guided as much as possible by what is natural, by what takes place when the hen does the hatching and brooding. The conditions the hen furnishes are those that we must provide in her absence, and the way the eggs hatch, or fail to hatch, the way the chicks thrive best or fail to thrive are where we must look for pointers to put us on the right track. Bear this in mind.

WHEN THE CHICKS ARE HATCHING.

Never disturb the eggs when the chicks are hatching. Before this interesting time you can be more or less careless in handling the eggs, but after they begin to pip, keep hands off.

If the eggs are uniformly fresh and fertile the chicks should begin to hatch during the night of the twentieth day, or the forenoon of the twenty-first day, and 90 per cent of them should be ready to remove to the brooder by noon of the twenty-second day at the latest. Where eggs are of different ages, some of them fresh-laid, some of them one week old, some two, three, four and even five weeks old the hatching will reach out over four or five days, some hatching on the twenty-first day and others hatching along until as late as the twenty-sixth day. It is, of course, best to have eggs as fresh as possible. In cool or cold weather they can be kept as long as four weeks, and will hatch strong chicks, but it will take these old eggs some longer to hatch, and eggs not over two weeks old are much to be preferred.

When fresh eggs are used and none of them begin to hatch until the twenty-second or twenty-third day, this is proof positive that not enough heat was applied during the period of incubation, thus retarding the development of the chick in the egg and delaying the hatch. Make sure that the bulb of your thermometer was on a proper level in the egg-chamber, and if satisfied it was, then run the machine a degree higher throughout the next hatch. Half an inch up or down in the egg chamber, as regards the bulb of the thermometer, means often as much as a full degree of difference in the temperature, hence the importance of this matter.

It is a good plan to make notes throughout each hatch, keeping a record of the temperature, taken every twelve hours, and noting down any other items in regard to testing the eggs, the application of moisture, the amount of ventilation used, etc. Then when you make any variation you can note results. The most important point is to know all about your eggs. Eggs used for hatching, in order to obtain the best results, must come from vigorous stock, that is, in good breeding condition, meaning not too fat; must be uniformly fresh and really should be from the same breed. Considerably better results will be obtained from two hundred Leghorn eggs, two hundred Plymouth Rock eggs or two hundred Brahma eggs, run separately, than would be the case if a third each of the three kinds were placed in the same incubator and run through the hatch together. These eggs vary considerably in thickness of shells, hence the same amount of moisture will not do for all of them and not so good resuts will be obtained in this way. All possible pains should be taken in matters of this kind, and then the owner of the incubator will be satisfied with his or her investment, and will not join the ranks of those who are indifferent in their methods and then blame somebody else.

GENERAL CARE OF INCUBATOR HATCHED CHICKS.

Brooding, Feeding and General Treatment—Small Quarters—Water or No Water—A Brooding Coop.

BY J. L. CAMPBELL.

BEFORE proceeding with the subject proper, I wish to make a few remarks on the supposed difference between chicks which are hatched in incubators and those hatched by hens. It is only of late years that any large number of poultry raisers have been willing to admit that there is no difference between incubator and hen hatched chicks, and there are plenty of persons who still believe that a chick hatched in an incubator always has flesh of inferior flavor to those hatched by hens. Such an idea is purely imaginary and arises from the fact that with a certain class of people it has come to be a common thing to class all inferior stock as incubator hatched. Whenever there is any difference between hen hatched and incubator hatched poultry the difference arises from the manner or method of raising and not of hatching. Chicks hatched from eggs laid by good, strong, vigorous stock in perfect health, at a temperature between the two extremes of 101 and 105 degrees, are and always will be exactly the same in every respect, whether hatched in an incubator or hatched by a hen.

It might naturally occur to many that stock which is strong and vigorous must of necessity be healthy, but not so. A strong, vigorous man or woman can be sick at times, so can any sort of animal, and poultry is no exception to the rule. Therefore it goes without saying that no person need expect to raise good poultry unless the eggs are laid by healthy hens. A bright red comb on a hen which is as lively as a cricket is considered by most poultry raisers as a sure indication of good health, and it usually is, but it can not be relied on absolutely, because a hen may be in an advanced stage of either roup or diphtheria and show no signs of it in her comb. The very first effect of roup is felt in the generative organs or ovaries, and thus the eggs are one of the first things to be affected.

In handling the subject, as stated in the heading, we are going to suppose that in all cases the chicks have been properly hatched by heat between 101 and 105 degrees and not between 90 and 110 degrees. I should like you also to bear in mind the fact that a hen does not always keep the eggs at the proper temperature; they will vary from 98 to 110 degrees, but in all my experiments with hens I never had good success with their chicks when I found the eggs heated above 107. The chicks often get out only to die afterwards, but when the heat gets below 100 they always fail to get the chicks out at all. The majority of good sitters, however, maintain a temperature between 101 and 105.

For the past five years I have been experimenting specially with hen hatched and incubator hatched chicks and turkeys, both kinds raised together, both with hens and brooders. While there was really no difference between the chicks when they were hatched at the same temperature, yet the average number raised both by myself and others was the highest in the case of the incubator hatched. The incubator turkeys did the best every time. They were raised with hens in all cases, except that some of them were kept in the brooder for the first week, and these usually did the best of all. But we had no success if we kept them in brooders longer. I had four incubator hatched gobblers go to twenty-eight pounds at ten months, and they were heavier than any that were hatched under the hens.

FIRST CARE OF NEWLY HATCHED CHICKS.

All that the chicks need for the first tweny-four to thirty-six hours after coming out of the shell, is to be kept perfectly comfortable and quiet. I seldom use any other thermometer than the chicks themselves, but will state that 95 to 98 is the proper temperature. A thermometer laid among the chicks should not exceed 100, but bear in mind also that 95 on a warm day is as warm as 100 on a cold day; in other words, the chicks will be as comfortable in a brooder at 95 on a warm day as in one that is 100 on a cold day. Also remember that when we say brooder at 95 or 98 we mean with the chicks in it. If you make it 98 and then put in the chicks you will very soon have about 110. The empty brooder should seldom be warmer than 90, the heat of the chicks will very soon make the balance. No reasonably intelligent person need ever make a mistake if he simply will watch the chicks, as they are the best possible guide. If they are just warm enough they will lie around perfectly contented and sleep without getting on top of each other. If too warm each chick will try to flock by itself, and pant; if not warm enough they will crowd up in a bunch, and the colder they are the harder they will crowd. Chicks which have spent one night only in a jam are ruined beyond redemption. A part of them can always be raised with good care afterwards, but few of them will be found perfect at maturity—they may be deformed in every way imaginable. It is this one thing of crowding and jamming in a corner that has caused more trouble in raising incubator chicks than all others combined. Some wise people have supposed they had solved the problem by making round brooders, or brooders with round corners. It is quite true that chicks can jam tighter in a square than in a round corner, but they can jam where there is no corner at all quite hard enough to do the mischief. The only way is to prevent crowding at all. There are a good many things which will cause chicks to crowd, but one thing alone will prevent it, and that is warmth. Chicks that are improperly fed, or are weakly from other causes, will crowd if in a brooder that is warm enough, but even they can be stopped from crowding by using more heat. Young chicks need heat more than food. It is absolutely necessary, and they will neither grow nor thrive without it, yet there is nothing worse that can happen to young chicks than to be overheated any time during the first week after they are out of the shell. It is just as bad to overheat them after they are hatched out as while they are in the shell.

Fully half the persons who buy incubators, and I believe a greater number, have an idea that if they can only get the chicks hatched they can easily raise them, hence they will buy the best incubator they can get, and then very often, as I well know, try to raise the chicks without any brooders at all. It is quite true that chicks can be raised in almost any kind of an old box, provided they are kept warm and dry, with plenty of fresh, warm air, and are well fed; but lacking any of these essentials the result will be partial or total failure, whether the brooder cost fifty cents or fifty dollars.

The care of the chicks for the first thirty-six hours is all a matter of brooding. This is the first step and is almost all important. My chicks, for the first three days at least, are always placed on a soft cloth of some kind in the brooder. An old, worn out ingrain carpet suits me better than anything else, and jute sacks are very good; in fact, anything soft and rough. Young chicks must never, under any circumstances, be placed on a smooth surface of any kind. Smooth boards, tin, sheet iron, and glass (I have seen all these used for chicks to sit on) must never be used as a bottom for a brooder unless kept well covered at all times with litter, but the old woolen carpet, kept a little warm, is simply perfection for the first three days. It entirely prevents sprawling, while a smooth surface of any kind will always produce more or less crippled chicks. Warmth, quietness and an abundance of fresh, pure air is all that is needed for the first twenty-four to thirty-six hours, as above stated. Then we are ready for the second step, and it is not hard to stumble here.

In the matter of feeding there never can be any ironclad rules, as there are for brooding. The essential points given above absolutely must be had in a brooder if complete success is to be attained, but in the matter of feeding a great deal of latitude can apparently be allowed. I use the word apparently advisedly, because it is really only apparent. Perhaps I can make my meaning plainer by stating that it is not so much what the chicks are fed as how it is done that makes the difference between success and failure. I have tried any and all methods that I could think of, or rather all kinds of food, and I find that chicks can adapt themselves to almost any sort of food if it is fed to them in a proper manner.

METHOD OF FEEDING.

As I stated before there is no iron clad rule for feeding chicks. For many years in succession I have cooked all the food of every description which was fed to my growing chicks. I have also, for years at a time, fed it all raw. I have used salt daily in the food and I have fed without using any at all during the whole season. I have used nothing but ground food until the chicks were fully grown, and I have raised them entirely on whole wheat. I have fed oat meal, both dry and cooked, and in regard to it I will say that I do not feel like bragging about my success with it. I find it excellent after the chicks are as large as quails, but I never could succeed so well as I wished when I fed it from start to finish. Sometimes they did well, and at others they did not. But when using wheat and corn, coarsely ground (from half to two-thirds corn and the balance wheat), I never had any trouble whether it was fed cooked or raw. This ration can be made one-third bran after the chicks are six weeks old with good results. I always insisted on having the very best wheat and corn. Nothing but perfectly sweet grains of either will I use. The grinding also is of the utmost importance, the regular merchantable corn meal being utterly unfit to feed chicks unless cooked, either steamed or baked. It is too fine and will pack if fed raw. It pays to get the feed ground, and you can get it done at any feed mill. It should be as coarse as clover seed.

Use this meal half wheat and half corn, or two-thirds corn, and for the raw food method proceed as follows: Wet it so you can stir it quite easily, and when you are done have it so wet that the water will rise and just cover the top. Then let it stand at least thirty minutes to swell. There should be no sign of water when it is fed. Use either milk or water to wet it with. Milk is much the better, and I like sweet milk best. When the meal is to be cooked either by steaming or baking, use more water or milk, else it will be too hard when cooked.

The above two ingredients I consider among the very best for feeding young chicks. I shall now give the various methods which I have used in feeding them, giving none which I have not used with good success in raising the chicks. I have always found that no matter what method I started with it was best to continue that plan. Any sudden change was always detrimental to the growth of the chicks. If I am feeding wet food and change suddenly to all dry, the chicks always stop growing as rapidly as they were. A change in the method of feeding should be made gradually. Note this: No matter what kind of food is used, or how it is fed, I consider grit of the very first importance. I would rather have 300 pounds of meal and one hundred pounds of grit than five hundred pounds of meal and no grit. When it was all fed I should have the most and the best chicks with the former, though I had started even in the first place. Good stale bread is a most excellent food, and I always use some of it when I can get it, especially to start the chicks.

FIRST FEED FOR YOUNG CHICKS.

Remember that when I say corn meal and wheat meal I always refer to the specially ground meal, as I never feed the meal that is sold in the stores.

Take sweet, stale bread and wet it either with milk or water until it will stir up in a thin batter, then stir in equal parts of corn and wheat meal until you have a soft batter. To this add what would be equal to ten per cent of the whole of chick-size grit and an equal amount of good beef meal. Stir this well and let it stand a half hour and if it is just right it will be rather crumbly, but soft. There will be nothing in it of more importance than the grit if complete success is to be expected, but whenever it is possible to get it, add to the first feed for young chicks some finely cut grass, fresh grass I mean. It can be had as early as most people begin to raise chicks. For the first feed but very little is needed, but always place it on a clean pan, paper or board. Try to give just what the chicks will eat up clean, but should any be left, remove it as soon as they quit eating.

The number of times to feed chicks daily is not as important as how it is done and what sort of food is fed. I have always had good success when feeding three times daily, and just as good when it was five times. Those who have time to feed five times and feed a little at a time, will perhaps induce the chicks to eat a little more than when they are fed only three times. If it is properly done they will do just as well one way as the other, but it is easier to overfeed by the five meal method than by the three, and overfed chicks soon cease to grow or thrive on account of indigestion. Unless they have plenty of room in which to run and exercise it requires great care to prevent overfeeding. It is much better to feed too light than too heavy. There is nothing better to keep chicks in good health and with good digestion than onions, but they must be cut fine. They may be mixed in the other food or fed alone—the chicks are always ready to eat them in any shape you want to feed them. I always make it a point to feed some at least once a day. A limited amount of potato is also good. They are best boiled with the skin on and then mixed with the other food, or feed them whole and let the chicks peck at them. Too much potato will cause bowel trouble. Cabbage, turnips, beets and rutabagas are all excellent, the latter perhaps best of all, both raw and cooked. Ripe apples also are good at all times. All these things serve for variety, and any or all of them can be used with good results.

When the meal is to be fed cooked mix it up in just the same way as when fed raw, but use twice as much water, else it will be too hard. Steaming or baking is the best way to cook the food. Place the meal in a vessel and set this inside of another one with a reasonably tight cover, and by keeping the water boiling in the outer vessel you can improvise a steamer out of any kind of kettle or pot. Food will go much farther when cooked than when fed raw, and the chicks can eat all they can hold and never get packed crops. It digests easier and on the whole I think it pays to cook it where the cost of fuel is not too much of an object. A little fresh meat and onions mixed in will be a great improvement at all times. The grit will have to be mixed in after the food is cooked, as it will all settle to the bottom while cooking.

Feed early in the morning, always. A chick is not thriving unless it is hungry in the morning. The crop should always be empty at that time, but never through the day. A healthy chick with an empty crop is always a hungry chick. If the crop is empty once in twenty-four hours that will answer.

Feed the last in the evening just before sundown. Chickens want to go to roost at sunset, or shortly afterwards, and should have all they will eat at that time. If fed too early in the evening the get too hungry before morning and are apt to eat things which will make them sick, as they will eat anything they can swallow at such times.

Chicks are the most peculiar little animals in the world in one respect. When they have had all they want or need to eat, they are not satisfied, but start off and begin hunting around for something else to swallow just to keep busy. This is why it is important to keep something for them to peck at, it keeps them busy and prevents eating what is not good for them. This habit of chicks accounts for the fact that the first lot of chicks that is raised in any particular place will always do better than the second lot. You may fence up a yard and place a brooder full of chicks in it and raise every one without trouble. Take those away and place a second lot in the same pen, giving them the very same care and food, and you will perhaps lose half or more of them. This result may be caused by various things, lice among others, but the usual reason is that the first lot of chicks found and picked up everything which it was possible for them to eat that was good for a chick, and much that was not good, so that nothing is left for the second lot. Where room is plenty it pays to raise but one batch a year in one place. This, of course, is not possible where room is scarce and several lots are to be raised. The only remedy is to keep the yard as clean as possible. Spade or dig it up when it can be done, for each lot of chicks, or what is much better, divide the yard with a movable fence and sow grain of some kind, wheat, rye or oats. Either one will grow and make a nice crop of grass in a short time, and the chicks will eat this and thrive on it.

NUMBER OF CHICKS IN A BROODER.

This is one of the most important questions to consider. I have proved that it is possible to raise as many as two hundred chicks in a single brooder, all in one lot. I have done it many times, and while it is possible to do so, I advise the use of small brooders. Even supposing that you succeed in raising as many with the large as with the small ones, the chicks will always do the best when kept in small lots. Thirty to fifty chicks is the largest number that can be kept by most people with success. A large brooder and a large yard or run will answer very well, but a large brooder and a small run require constant care to keep the chicks healthy and out of mischief; when they can find nothing else to do they will eat each other alive. They can be regular cannibals when they get started, and when they do begin that the only thing which will stop it is to take away all those engaged in it, as one or two will soon start the whole flock at it. When that happens you may about as well kill them all. The only thing to try is to divide them all up and scatter them around, but even that will sometimes be useless. I had that experience twice. The first time I lost only a few, the second time nearly half the whole lot before I stopped the trouble. I never could see any reason except pure cussedness for the cannibalism, but I soon learned that the only way to cure it was to prevent it entirely.

They never begin unless confined in small yards, so that a good, large run is a positive preventive, but where this is not possible the only other plan is to furnish the chicks with a variety of things to do. Keep them busy so they will have no time for mischief. Give them something to peck at all the time and feed some freshly ground butcher's scraps. Nail some tough pieces of lean meat along a board so they can all reach it. That will keep them busy and furnish good exercise. This was the only thing which I could find for them to do which would stop them from eating each other. I have had none of that sort of trouble for a good many years, but I am often called on by others for a remedy for the trouble. Leghorns are the worst and Rocks are bad also, but I never saw Brahmas do this. I never knew of chicks doing this except when kept in large flocks, and at ten days to three weeks is the age, so it can safely be stated that it is always caused by crowding. It is not for lack of food, because they will eat all they can hold and then immediately start on a chick and disembowel it, and they can do it in two minutes after they have learned the operation.

The best plan to adopt when using large brooders is to keep them with the brooder until large enough to do without heat and then transfer them to brooding coops in lots of thirty or less. The sooner the chicks can be induced to perch the better it is for them, both as to health and plumage. In a properly constructed brooding coop they will learn to perch in a short time. The coops should be made large enough to hold the chicks after they are fully grown. If the perches are placed one foot high they will usually take to them in a short time, especially in warm weather, and if they do not they can be taught to do so by placing them on the perches a few times.

All the openings must have wire cloth or mosquito netting placed over the inside and a glass arranged to slide over the outside to keep out rain and cold. If the chicks are confined to these coops until each flock learns its own coop they will stick to them until taken away. The mosquito wire is necessary both to keep out cats and rats and mosquitoes. When numerous the mosquito is worse on young chicks than lice. Those that are partly naked suffer most, but they bite all kinds, especially on the head.

After the chicks have been transferred to the brooding coops begin feeding some whole wheat, just a little at first, and as soon as they learn to like it they can be fed this once a day all they will eat. But to do that it is best to soak it a few hours, as they will fill the crops so full that when it swells there is danger of bursting them. I never could get chicks to grow as rapidly on dry food as on wet food, either cooked or raw, and as it is the rapidly growing chick which makes the best stock and pays the best, I think it always pays to use ground food. It is true that it is more trouble to feed it, and it is also true that they will do well on dry food, but much depends on the way the chicks are kept whether it is possible to raise them entirely on dry food. I never knew of any person raising a large number of chicks in close confinement on dry food exclusively. I have known it to be tried often, and have tried it myself, but it would not work. The chicks would die off no matter what was done. When they run at liberty all over the place they can be raised on nothing but whole wheat, or cracked corn, or what is always still better, both at once. Chicks raised exclusively on corn always get fat too young. It does very well if they are to be used for broilers or market purposes, but for stock either for breeding or eggs it will not produce as good birds as a variety of grain. Chicks raised entirely on wheat are not nearly so good to eat as those raised on corn, but a mixture of the two grains will always produce the best results, giving larger and more vigorous birds. When chicks have all the ground to range over that they can use, it will make but little difference what they are fed, as they will do well anyway. The idea that good chicks can not be raised in any other way than by hens arises from the fact that a hen will take a few chicks and keep them on the go from morning until night, which in the case of healthy chicks is just what they need. Take that same hen and confine her in a small place and the chicks do not grow any faster nor do any better than when shut up in a brooder.

You may take two lots of chicks with just one month's difference in their ages. Give both to hens, but place the earlier ones in a small yard, and feed them all they will eat. Give the other hen a five-acre field to run in and feed them mostly when you feel like it and let them go the balance of the time. When fall comes the last chicks will be the larger every time. I have tried that experiment often. A good range will take the place of a great deal of work and care, and the best breeding stock can only be produced on a large range, never in confinement.

WATER OR NO WATER.

It is all a matter of how the chicks are fed whether they need water to drink or not. They certainly can not be raised without water, but as the water and the food all go the same road it would seem as if it could not make so much difference whether the mixing were done before or after the food is eaten. I have followed the plan for many years of giving early chicks no water to drink until they were two to four weeks old, and I have kept them until three months without water, but the needed amount of water must be mixed with the food. I consider it merely a question of my opinion as against the chick's what the amount of water should be. I know that they do the best in every way for me when it is early spring and cold, when I give them no water to drink. But when the weather is warm I give them water from the start. The trouble about watering is that it is not possible to prevent them from getting more or less wet. There are devices to prevent them getting wet, but there is only one way that ever did or ever will work even reasonably well, and that is to fix it so that every chick can drink at the same time without crowding each other. No matter what kind of device is used, when the chicks crowd to get at the water they will spill it over each other after they get it in their mouths. Then of what benefit is it to have a fount so they can only dip in the beak? If they have it all the time they will soon kill themselves when it is cold. If you try to water them any other way than to let all drink at once they will get wet no matter what kind of a fount is used, and one good wetting on a cold day sets a chick back a week's growth. For that reason alone I adopted the plan of giving young chicks no water to drink when the weather is cold, but as it would not be possible to raise chicks on dry food without water I never try to do it unless the chicks are at perfect liberty. When they run out on a good range you can keep water before them constantly and they will not hurt themselves. Then they do not take time to drink too much, or drink simply for want of something else to do, but seem to drink just what is needed.

After beginning to give the chicks water it will not do to stop it. I have tried that often enough and I find that once you start you must keep it up, even though it may not be good for them. Once they get used to drinking they will not do well if you deprive them of water.

PLUMAGE OF FOWLS.

Many persons who buy eggs from fancy stock breeders at a high price and fail to raise any birds which fulfill their expectations, especially as to plumage, are very apt to pronounce the breeder a fraud. Sometimes they are right, but just as often it was due to the way the chicks were fed. There is no breed of fowls which will show the effects of improper feeding in the plumage quicker than Brown Leghorns. I can take a lot of chicks from the best Browns in the country, divide them in two lots and feed so that four out of five in one lot will show a great deal of white in both wings, and the other lot will show little or none. It is only the rapidly-growing, well-nourished and healthy chick which can produce fine plumage. Cracked corn and wheat is an excellent food for chicks, but feeding on that entirely in any kind of close quarters will produce not only stunted chicks, but many of them will have wings half-white. The greater part of them when they reach maturity will molt out and not show white again perhaps, but chicks raised from them will be certain to show more or less white. Weakly, poorly-fed chicks of any breed will not have fine plumage. A growing chick must have animal food or its equivalent to make the best and most rapid growth. The best equivalent of all is a large range where they can find plenty of bugs and worms. Such chicks will not only eat more food than if placed in confinement, but they will grow faster and larger and stronger, and will usually have fine plumage. If not it will be the fault of the stock.

The more food you can get a growing chick to consume and keep in vigorous health, the better the chick is likely to be when grown, yet an overfed chick will make the very poorest kind of a chick you can raise if you succeed in raising it at all. The way to get a chick to eat the largest possible amount of food is not to give it all it will eat. Just put down all the food they will eat and a little more and see how soon it will be until they eat less and less every time until they practically quit. I prefer to see them eat every bit and then chase you all over the yard for more. Then watch them stuff the next time you feed. It is so easy to overdo the thing. It is just like walking a tight rope, the least bit to one side and over you go. There is about one poultry raiser in twenty that can feed just the proper amount all the time. The easiest way for any person to learn is to take plenty of time. First put down about half what the birds will eat, and when that is cleaned up keep giving a little more until they quit. This will soon teach an observant person just how much to put down. I know persons who put down enough wet food in the morning to last all day and who raise some chickens, but it is a very poor way.

As stated before, the best food to produce fine plumage must contain animal food. I like best of all perfectly fresh butcher's scraps and a good bone mill which will grind quite fine. If it can be had at any time it is best ground up raw and fed at once a little by itself or in the food, just as you prefer. I believe to feed alone is rather the better way, but unfortunately most breeders cannot get it fresh every time, and the plan for such to adopt is to roast or bake enough to last a week or two weeks at a time. Do not burn, but just brown it, then grind it up and it will keep perfectly sweet in hot weather for a month, and, incidentally, it is much easier to turn the grinder when the meat is cooked.

Another good reason for roasting the scraps is that you can use the machine all through the hot weather without cleaning more than a couple of times; in fact, it will not smell bad if not cleaned at all if the machine is kept in a perfectly dry place. But if ground fresh it will have to be cleaned every day in warm weather and once a week in cold. This is absolutely necessary or the machine will poison the chicks.

The heads of cattle and sheep, if you get them as soon as life is out of the body, are hard to beat as animal food for growing chicks, but it is rather more work to cut them up than I like, although it pays if you can spare the time. In case you live next door to a slaughter house you can get nothing better and easier to use than a little fresh blood, just enough to color the food red, but unless perfectly fresh it is the worst possible food to make chicks or fowls sick. When fresh it is both stimulating and very nourishing and produces rapid growth. It can be cooked also in a steamer and is very good that way. It can be kept sweet several days in a cool cellar even in warm weather. Steer clear of tainted animal food of any kind whatever. It is always more or less poisonous, often fatally so, and is the worst food to produce bowel trouble that can be fed.

I am aware that it is not convenient, or even possible, for a great many poultry raisers to get fresh scraps or heads, while others have not the time to grind them if they had them. I am one of the latter, although I do use a great deal of it that way. Some prepared bone and meat may be used; but it should be purchased of responsible manufacturers who put up the meat before it becomes tainted. I have tried some brands which produce bowel trouble, but it was due to the tainted meat used.

All such foods should be fed very sparingly at first, say one ounce at a feeding for one hundred chicks one week old, and gradually increase it until at two weeks old three to four ounces are used. It must depend on the chicks, as all kinds of chicks do not eat the same amount of food. The quantity can be gradually increased until at the age of three to four months one-fourth ounce to each chick per day is used.

LICE.

It is quite common to hear it said that lice never trouble incubator chicks, but it is an error. It is true that so long as you keep them in perfectly clean quarters and away from hens or sparrows they will not get lice on them, but every chick that runs out doors is sure sooner or later to get some on somewhere or somehow, regardless of what care is used. The louse is the one enemy that is never conquered. They can be kept down, but never abolished. I have had poultrymen tell me that there was not a louse in their flock, and I have caught a hen and seen dozens on her in a minute. The trouble is they do not know how to look for them. There are several kinds that are so lightning-like in their movements that it is only those who know how to look for them that ever catch sight of them. They are of several colors, yellow, blue, gray and so nearly the color of the skin that it is almost impossible to see them. The casual searcher, in fact, never does see them, therefore he says there are no lice, but the lice are there all the same.

The way to catch sight of these fellows is to hold the fowl firmly by the legs, lay it on one side in a good light and then turn the feathers rapidly backwards clear to the skin. Watch the skin and you will see a blue streak or gray, as the case may be, but no lice. They just leave a streak and follow the feathers as rapidly as you turn them over. The yellow lice are not quite so hard to see, as they stick along the feathers and are not so fast travelers as the others, but they have a bad habit of collecting in bunches. You may look a fowl all over and almost decide there is not one on her. Then all at once you will find a regular nest. These yellow lice never suck blood, at least I never yet saw one that had red blood in it, but the other kind live on both blood and the colorless juices of the flesh and are particularly harmful. There is also a large gray louse which causes the death of thousands of chicks. They are so large that even when full of blood you have to look closely to be sure there is any blood in them. One or two of these will kill a chick, as they work only in the throat. The yellow lice seem to feed entirely on the scales of the skin, and while they are the least harmful of all, if numerous they cause great irritation of the skin, especially around the vent. If you find a fowl all red and raw-looking at that point the lice are there, whether you can find them or not.

All these varieties of lice usually lay their eggs only on the head and throat where the fowls can not get at them to pick them off. But when they become very thick they also will lay the eggs on the feathers under the wings and all down the neck, and when they are that bad the fowl has no ambition left to pick them off.

Chicks when hatched only in the incubator and placed in a clean new brooder have no lice to start with, provided always that you are very careful to see that none were on the eggs when placed in the incubator. But watch the heads, never letting more than a week go by without an examination. I make it a point to examine some daily, using a magnifying glass to look on the heads for nits. The first time you see even one grease the head and throat of every chick, just a little. Use either lard, vaseline, or chicken oil —the hair of the dog for the bite! Use only a little, for if you grease a chick all over it is almost sure to kill it. Put a little also under the wings. If the down is greased all over the chick might as well be wet with water. Do this once a week or as often as you can find a sign of lice. When chicks are placed with hens grease them at the very start whether any lice or nits are on them or not. A chick which gets a few lice on it at first is always more or less stunted and often the feeding method is blamed when it is all due to lice.

To keep them off the fowls a good dust bath of fine dust is as reliable as any other method. Use very fine sifted coal ashes with a small amount of either fresh wood ashes or air slacked lime. Too much lime is not good for the skin. If you do not like the dust bath in the poultry house, which I do not, make them a shed outside in some place where it is dry and sunny, and if they do not use it enough scatter grain in it to make them scratch for it, putting the dust in a deep box. Snuff, powdered tobacco stems, or crude carbolic acid is excellent to mix with the dust. A pint of acid well mixed with five bushels of dust will last as long as the dust and will not hurt the fowls in the least. This is really the easiest method there is to keep down lice. Except for one reason only, and that the larger amount of labor and time involved, there is no plan which I have ever tried that I like so well as to dip the fowls into tobacco water. They enjoy it immensely on a hot day, and it must not be done at any other time, unless in a very warm house heated to at least 80 degrees. I use one-fourth pound paper of Weyman's cut and dry to one gallon of water. Steep it in hot water almost to the boiling point for two hours, then squeeze dry to get all the strength you can. When just blood warm dip the fowls all under but the head. It takes from one minute to five to wet a hen, the Brahmas being the hardest of all to wet. You must work it all through the feathers until every one is soaking wet, because if a dry feather is left it will have some live lice on it. Then grease the head where it is not wet, as the tobacco will not kill the nits unless soaked a long time, and not then if fresh laid. The dipping does not spoil the plumage in the least as I was afraid it would until I tried it. In a week's time the fowls are smooth as ever and much cleaner. Leghorns and all the small breeds are easy to wet, but the Asiatics are hard to wet, and it is no use to do it at all unless a clean job is made of it. You will not find a louse of any description for a long time afterwards. Two dippings a years are enough to keep them clean, and it will pay any one to do it who can spare the time. I fully believe the fowls are more healthy than when the dust bath is used so much. Why should not fowls be healthier if kept clean as well as human beings? I heard an old man say that his body had not been washed for thirty years, but my opinion is that he lived so long as he did because the perspiration and his clothes washed him. It is quite common to hear it said that fowls do not perspire, but that is all a mistake. I do not know of any fowl or animal which does not. I have had fowls and chicks sweat until they were as wet as a drowned rat, and if they can be made to sweat that much why is there not imperceptible perspiration on them as well as on any other animal? At any rate, I like to keep my fowls with a clean skin, therefore I always dip twice a year, when I can, otherwise I use the dust bath.

Young chicks can be dipped if immediately put in a very warm brooder until dry. I tried it on some young turkeys, but got scared and quit, as I thought they were dead. I placed them in an incubator and they came to life again and seemed none the worse for it. As I am uncertain whether it was the smarting of the tobacco or the chilling, I do not recommend it for turkeys. They are so much more delicate and easily killed than a chick that I did not try it the second time.

GAPES.

I will close this part with a little information about gapes. This is one of the meanest troubles to which chickenhood is heir. I expect it will be always a puzzle where they come from, although some people seem to think they know. Some claim they come from eating earth worms, but I kept a standing offer for a number of years of $50 in gold for enough earth worms to give one chick the gapes and I never got them. For my part I know just two things about them which are of any benefit to me. The first is how to eradicate them, and the other is how to cure the chicks. To eradicate them skip one year entirely and do not raise a chick before September. For some years prior to 1880 every chick I tried to raise would get the gapes. In 1880 I got all my chicks raised elsewhere and did not have one on the place until September. They did not take the gapes and I never had a case of it until 1897, when four chicks had the worms. The next year about thirty had them. If they are bad one season I skip the following year. That will clear them out totally, and to my mind disposes of the earth worm theory.

The best thing to cure the gapes is a wire the size of a horsehair, very smooth and bright. In lieu of a better one pull a wire from a window screen, smooth it down straight and polish it and it will do, but it is rather soft. Stretch the chicks up straight and drop the wire to the very bottom of the pipe, with thumb and finger give it a twist and withdraw the worms. It takes two persons to do this properly, one to hold the chick and the other to pull out the worms. This method can be safely used only with chicks the size of quail and larger. It is slow but sure, as they will nearly all get well. For smaller chicks place them in a tight box, get a hot brick or iron and drop carbolic acid and water enough on it to start them to coughing and sneezing. The fumes kill the worms and the chicks cough them out. This is better than the lime dust method, but as stated, the only satisfactory method is to let some person who has no gapes raise all your chickens for one season, or else do without and buy what you need.

BROODING COOP.

Figure 1 shows the complete coop. This is not a brooder in any sense of the word, as it is not intended to have any artificial heat, but is to be used simply to transfer the chicks to after they are old enough to leave the brooder. They are good for use either with or without hens. These coops can be constructed very cheaply out of large dry-goods or store boxes. A good size for thirty chicks, to accommodate them until grown up, is 3x4 feet. The higher they are the better, but they should be at least two feet on the lower end. A single sheet of galvanized iron 30x96, cut in two, will make the roof and have a piece left which comes in handy to make the doors. The iron should be turned down (see w, Fig. 2) one inch all around to make it stiff. A cover of boards is first made from the lid of the box and the iron is fastened on it. But a very slight slope is needed to carry off the water, in fact the roof can be almost level if desired.

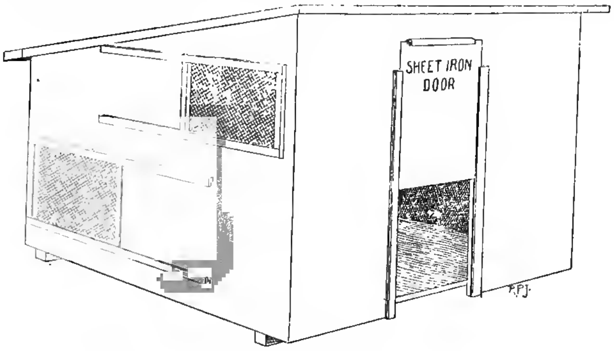


Fig. 1.—Brooding Coop used by Mr. J. L. Campbell.

The bottom or floor is nailed firmly to two strips which hold it up off the ground at least two inches. Then the bottom is cut to fit inside neatly so that the sides and ends extend below the bottom a trifle all around. This is of the utmost importance, as it keeps all water from running in no matter how hard it rains. It will not do at all to set the sides on top of the bottom, as the floor will in that case get wet every time it rains.

By this method of construction the coop is in three parts, roof, sides, and bottom all separate, so that it is very convenient to clean out. Just lift off the top and sides and sweep it clean, as it will always be dry if plenty of dry soil is kept in it all the time. The oftener it is cleaned the better, but once a week will do if you cannot do it oftener, always with the understanding that the bottom is well covered with dry soil.

The two bottom strips stick out far enough to catch the sides and keep them from dropping down too far. For the windows simply cut holes, in the sides only, and then nail wire cloth over the inside, and rabbet two strips for each window. Nail these on the outside of the coop for the glass to slide in. A single pane of glass 9x14 is a good size for each window. But any size convenient will do so it is not too small. Place the door in the high end always. This is simply a hole, cut eight inches square. Then use a couple of the rabbeted strips same as for glass, and a sheet iron door to slide up and down. The ends of the coop should be one inch lower than the sides. Then when the cover is on there will be a one inch opening (see T, Fig. 2) at the top of each end. This is to be covered with wire netting to keep out anything that has no business inside, including rats and mosquitoes, and always insures ventilation whether the windows are closed or open. The coops should always be set with doors facing east, as the wind is usually from the west. Then it will seldom be necessary to close the windows to keep the rain out.

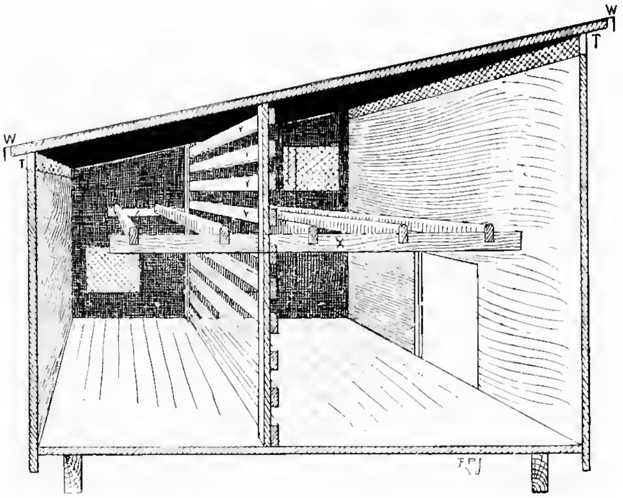


Fig. 2.—Showing the Arrangemegt of the Inside of Mr. Campbell's Brooding Coop.

Fig. 2 shows how to arrange the coop inside. The partition (Y) across the back end is for use only when the chicks are running with a hen. They can be fed in the back part so as to prevent the hen from scratching the food into the dirt. When the coops are used without a hen the partition can be lifted out.

A notched strip (x) is nailed to each side to hold the perches, which must drop in so they can be lifted out when necessary to clean out lice. The perches can be either round or flat to suit the ideas of the user. If flat they should be four to six inches wide, to my mind there is not much difference. When a chick grows so rapidly that the perch will spoil the breast-bone, as it frequently does when they begin perching too early, a round perch makes the impression of the perch in the thin keel of the breast-bone, while a flat board will turn it all over and make the bird flat like a duck. In either case such birds are best on straw until the bone hardens. Even then there must not be enough of them together to jam or they will be squeezed out of shape otherwise, which will be just as bad. A perch must never be placed close enough to a wall so the birds can get their tails against the wall, else there will be plenty of wry-tailed birds.

I have tried innumerable styles of brooding coops, but this is the only style which ever gave me perfect satisfaction. It fills the bill in every respect. If they are made the proper size they will hold thirty chicks each, without crowding. It is but a few moments work to go around in the evening and drop down all the doors and so make them safe from vermin of all kinds, including mosquitoes. If it is raining in the morning, and you do not want to let them out, they can be fed in the coops. When fall and the frosts come you can feed them in the coops and keep them shut up until the sun comes up and thus guard against the first start of roup. They can be left with the coops until time to put them into winter quarters.

The coops should be left exposed to the weather all winter so as to freeze out any lice that may happen to be left over. You are in luck, sure, if some do not escape. Shut the coops up tight and fumigate, in the spring, and they are ready for a fresh lot of chicks.

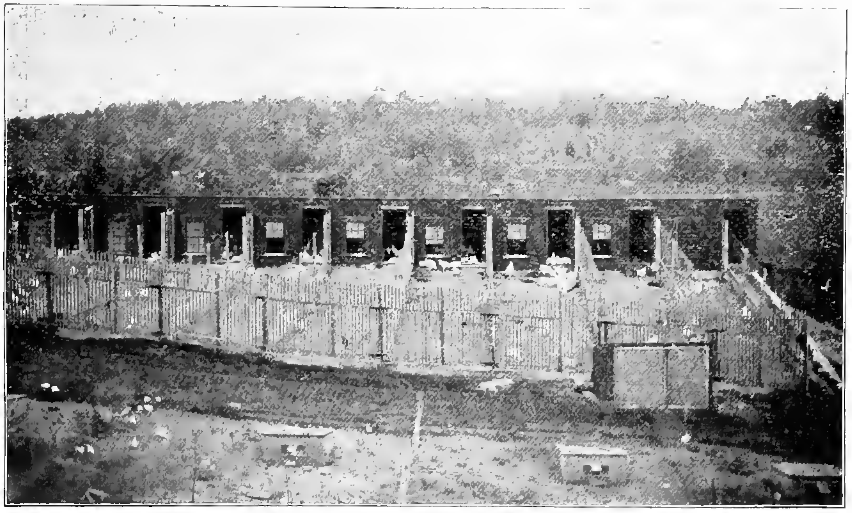
RAISING THE CHICKENS.

Some Thoughts on Brooding, Cooping and Feeding Chickens.

BY A. F. HUNTER, SOUTH NATICK, MASS.

HATCHING the chicks is but half the battle, if, indeed, it is half the battle, as many a poultryman who has rejoiced in good hatches by either hen or incubator has afterwards learned to his sorrow. With incubator chicks raised in brooders elbow room seems to be a most important factor, and want of elbow room is one cause of great mortality in brooder chicks. It is quite natural to suppose that a brooder which is three feet square (giving nine square feet of floor space), is abundant room for seventy-five or one hundred chicks, and, indeed, it is for chicks as they come out of the incubator, and if we do not want our chicks to grow it is all right to crowd into a brooder twice as many as should be in it. A point that we should keep in mind, however, is that these chicks will be fully twice as large at three weeks old and probably four times as large at five weeks old, or by the time we move them from the brooder, and that factor we should have in mind in gauging the capacity of a brooder. I have come to believe that for good results fifty chickens are as many as should be put in any brooder; that to increase the number beyond that point is to induce crowding, which kills some and stunts others, and is extremely unfortunate if quick and profitable growth is our aim.. If, as not infrequently happens, we find we have 150 chickens in the incubator when we only expected about 100, and have but two brooders heated up to receive them, no harm will result in put-75 chicks in each of the two brooders for a couple of days, but another brooder must be made ready at once and the 150 chicks put into the three, which gives reasonably abundant room for all of them and they have a good chance to grow.

We raise chickens on our farm for two purposes, first for market, second for breeding stock. The chickens for market are hatched usually from about Christmas time to the middle of March. Those intended for breeding stock are hatched from about the middle of March to the middle of May. To have chickens out by Christmas time we must have an incubator started early in December, and at that time it is our custom to start one incubator a week, or, possibly, four incubaors in three weeks, gradually increasing to two incubators a week through January and February, and so on. For these winter chicks we have a brooder-house 130 feet long by 10 feet wide, partitioned into sixteen pens 8 feet by 10 feet, each pen having a door and window in the front which faces the south. This brooder-house is double walled, with a four-inch air space between the inner and outer walls (it would be better still if the wall and roof spaces were packed with straw or swale hay), and the only artificial heat used in this house is in the brooders themselves, excepting that in some severely cold weather we put a small oil stove in each pen to take the chill out of the air, in order that the chicks may be out in the pen. We use "Peep-o'-Day" brooders, which are three feet square, heated by an oil lamp with a one and one-half inch wick, the air which passes into the brooder being heated by passing over a sheet iron ceiling to the lamp chamber, and by this method of applying the heat indirectly a slight current of warmed fresh air is passing into the brooder all the time. Herein, we think, is one of the great faults with many brooders as, for example, the hot-water pipe brooders in use in many brooder-houses. Those hot-water pipes simply heat the air already with the hovers, which air is practically confined to the hovers by the felt curtain in front, which is supposed to enclose the warmth within the hovers. It does that very well, but it likewise encloses the air, which the chicks have to breathe over and over again, and in that defect I think we find a clue to not a little of the mortality and consequent shrinking of profits on brooder-house chicks. A current of warmed fresh air supplied to the hovers would overcome this serious difficulty, and would, in my judgment, materially reduce the mortality of brooder chicks.



PART OF LONG BROODER HOUSE.
The foreground showing brooders out of doors, each brooder inclosed in a pen 20 feet square, made of 18-inch netting.

The "Peep-o'-Day" brooders are set in the ground to a depth of six or seven inches, which serves a twofold purpose. The lamp chamber is enclosed so as to cut off currents of air, and the chicks run out and in upon a level. For our winter chickens the brooders are set in the middle of the pens in the brooder-house, or, say, about four feet back from the window, and two pieces of board are fitted into slots at each front corner, extending to the side of the pen, so that the chicks are kept in that warm, sunny half of the pen until they are a week to ten days old. The first day after being removed from the incubator they are usually kept confined to the brooder, the food being put on small tin platters placed in the corners of the brooders for them.

After they are old enough to be let out they are fed and watered outside, just in front of the brooders. These winter chickens will need the warmth of the brooders until they are seven or eight weeks old, but the temperature of the hover is gradually reduced from 95 degrees at the beginning to 90 or thereabouts at the end of the second week, then to 85, then 80, then 75, and the last week or so that the chicks occupy the brooder the flame of the lamp is kept as low as it can be run, to give just the least amount of warmth, 65 to 70 degrees being sufficient.

The chickens that we raise for breeding stock are brooded out of doors, it being our custom to begin setting brooders out about April 1st, the brooders being set in the ground, just as formerly inside the brooder-house, but, as we have much rainy weather in April and May, we have "shelter boards" to serve as protection from the rain, set a little way in front of the brooders, and under which the chicks can take refuge from the storms. The chicks put out of doors are kept within the brooder for about one day, then a little pen a yard square made of three pieces of board three feet long set up to the front of the brooder gives them a snug enclosure for the few days of babyhood. Next we make a pen about twenty feet square of one inch mesh wire netting tied to temporary stakes, and the chicks have the range of this pen until they are big enough to be weaned from the brooder, which, in May and June, is at about six weeks old. Then they are moved back to a grassy ridge bordering the pasture on one side and mowing field on the other. There they are colonized in "A" coops (as we call them) for five or six weeks, when it is time to separate the pullets from the cockerels, and put the pullets out in the grass fields, in roosting coops, in families of about twenty-five each, colonized about fifty yards apart. The cockerels intended to be raised for breeding are confined in pens about 50x100 feet, while the cockerels intended for market are taken back to the pens in the brooder house, which have small yards 10x20 outside, and there they are fed and grown for market.

BROODERS AS USED OUT OF DOORS.
The one in foreground has a very small pen for baby chicks.

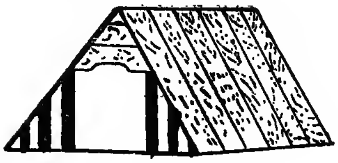
The coops for these chickens play a not unimportant part in chicken raising, and a brief description of them may be interesting. The A coops are three feet six inches by two feet three inches on the ground and two feet high at the apex of the roof. They are built throughout of half-inch tongued and grooved pine and well painted. The front is all slats, as shown in the illustration, with a slatted gate sliding in grooves to close the front. We originally built these A coops to slope down to the ground, but found it an improvement to have a square base, four inches high, with the corners turned at an angle, to prevent the chicks from crowding back under the eaves and smothering one or two at a time. We find it a most decided advantage to have these well built coops always at hand, and as we have coops now in use which were built ten years ago and are as good to-day as when made, the economy of well made coops will be apparent. When we say that the tongues and grooves of the roof pieces are painted before they are put together, the reader will realize that they are thoroughly well built.

The roosting coop, which is chiefly intended for raising the pullets in, is six feet long, three feet wide, two feet high at back and three feet high in front. The roof, ends and back side are all of half-inch tongued and grooved pine, the front being all laths, set a lath width apart, except that a strip of board is nailed to each corner for stiffening. Two roosts of two by three scantling, slightly rounded at top, run the whole length and are a foot apart, being securely nailed to a frame of furring (one by three stuff) nine inches from the ground. To this frame we nail the ends, back side and front corner boards and then fit in at the top a frame of inch-square stuff to nail the roof boards to and to stiffen it. A coop like this will comfortably house twenty-five to thirty chickens until they are nearly grown, in fact we sometimes have pullets begin to lay before they are brought in from those roosting coops. It is quite light and can be easily moved on a wheelbarrow, or moved its length or width to fresh ground, or it can be tipped up and the droppings removed, and it is a perfect summer shelter. If they are to be used in the spring or fall, when the nights are cold, an improvement would be to make a front of half-inch boards, hinged at the top edge, so it could be swung outward and upward and rest upon folding legs hinged at the bottom corners, which would become a roof to shelter the birds from rains. One disadvantage of this light coop is, that it may be easily tipped over by a high wind, especially when the chickens are all out of it, as during the day. To prevent it from so tipping over a flat stone should be placed on each front corner of the roof.

The gate space in front of the coop gives access to the whole inside when the pullets are to be removed. The gate is made of laths nailed to two strips one inch square, the left hand ends of which are long enough to slip in behind the lath front, the right hand side being secured by one or two buttons. If one prefers, these gates can be hinged at one side or the other, and secured by a hook or a button, but we have found it a convenience to have them wholly detachable, and so make them.

Shelter from rain and sun is of quite as much help as a good coop to sleep in. By experimenting in different ways we learned that it would pay well to have "shelter boards" always ready, just as are the coops, hence we make them of the half-inch, tongued and grooved pine, taking five strips three feet long by six inches wide for each shelter board.

These strips are securely nailed to pieces of inch-square spruce at top and bottom, and then the weather side is well painted. We make a light frame of the inch-square spruce strips and laths to fit up to the A coops when we want to put the shelter close to the coop, using one of the 2½x3 foot shelter boards as shown in the illustration. As the chicks get a little older we move the frame out a little, set athwart the front of coop, and put two shelter boards over it side by side, setting it so that a furnishes shade if the sun is shining, or protects from a driving rain, of course adapting it to the direction of the wind.

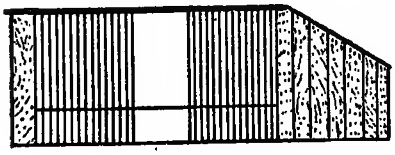

The A Coop.

When we move the pullets out into the field and into the roosting coops we set upon stakes and a strip of furring, a shelving roof seven and a half feet long by three feet wide, slightly sloping to the south, about eighteen inches high in front and a foot high at the back. By these devices we more than double the available shelter from rain and sun and correspondingly increase the comfort of the growing chicks. Obviously, if they have to be crowded into their narrow sleeping quarters on a long rainy day or to get away from the hot sun, they are not making good growth, and by so simple an expedient as we have here outlined we more than double the protection and by so much promote their comfort.

FOODS AND FEEDING.

As we stated at the beginning of this article, we raise two kinds of chicks, chickens for market and chickens for breeding stock. The food for the first month or six weeks is practically the same for each class, but at the end of six weeks we begin to feed the market chicks a richer and more fattening food, they of course being kept separate from the chicks intended for breeding stock.

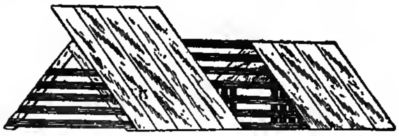
Feed often and feed but a little at a time is the rule for young chicks. We feed five times a day until they are about six weeks old. It is important that no food be left standing for the chicks to trample dirt into or to get sour in the sun; if they have not eaten it all in twenty minutes to half an hour, remove it. Nothing causes more bowel looseness and dysentery than sour food. Our chief foods for the first six weeks are coarsest oatmeal, slightly moistened with sweet milk if we have it, if not, with water, and waste bread ground to rather coarse crumbs in a bone mill. This also is moistened with sweet milk or water,—slightly moistened, so that it is still crumbly, and not "pasty." The oatmeal is just such as is cooked for a breakfast dish on our table; in other words, it is oat meats ground very coarse. This we buy of wholesale grocers, by the barrel, at a cost of about two cents a pound. The waste bread is the broken pieces, part loaves, rolls, corn cakes, etc., from hotels and restaurants and costs about a cent and a half a pound. This bread we buy by the hundred weight and spread on the barn loft floor to dry; when thoroughly dry it is ground into coarse crumbs in a bone mill. The first food early in the morning is the bread crumbs, slightly moistened with sweet milk or water; the second, about nine o'clock in the morning, is oatmeal slightly moistened, a little before noon bread crumbs again, about half past two oatmeal again and about five o'clock a little cracked wheat or finely cracked corn. Twice a week a little lean meat is boiled, chopped fine and mixed with one of the bread or oatmeal feeds, or the infertile eggs (clear eggs) from the incubators are boiled hard, chopped fine, shells and all, and mixed with the bread crumbs or oatmeal.


Roosting Coops for Large Chicks.

It is very important that the chicks have grit to grind their food, and as baby chicks are hardly to be trusted to supply themselves with good grit, we sprinkle a pinch of fine grit (or coarse sand) upon the small tin plates once a day just before feeding, or, if preferred, it can be mixed into the food. Grit in the gizzard to grind food is a most important factor in preventing indigestion and looseness of the bowels.

Green food is another important aid to good health. If the chicks are cooped upon fresh grass the problem is easily solved because they will help themselves. Obviously, the January, February and March hatched chicks cannot have access to fresh grass, neither can the larger chickens shut up to be fatted for market, hence a supply of green food must be provided. Cabbages, onions, lettuce and onion tops all make a good green food, which, for the baby chicks should be chopped fine in a vegetable chopper. As soon as the grass begins to grow the lawn mower trimmings are an excellent green food supply, and the same can be said of weeds from the garden, which are easily obtained. It is a comparatively easy matter to supply the green food if one has the will.

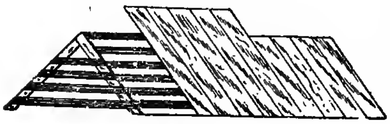
We are well aware that many readers of this cannot get waste bread from hotels and restaurants, and to such we recommend the making of a "johnny cake" of mixed meals baked very thoroughly, and we will give also the rule for "Excelsior Meal bread" as recommended by Mr. I. K. Felch. "Grind into a fine meal in the following proportions: Twenty pounds corn, 15 pounds oats, 10 pounds barley, 10 pounds wheat bran. Make the cakes by taking one quart of sour milk (or buttermilk), adding a little salt and molasses, one quart of water in which a large heaping teaspoonful of saleratus has been dissolved. Then thicken all to a little stiffer batter than your wife makes corn cakes. Bake in shallow pans until thoroughly cooked. We believe a well-appointed kitchen and brick oven pays, for in the baking of this food enough for a week can be cooked at a time." It is very certain that a cooked food of this kind is a decided help to good grow htin chicks, and as we on our farm want a good growth, we study to promote it by feeding a good food.


As a Shelter from Sun.

Not a few farmers and poultrymen think that oatmeal as a food for chicks is a luxury. Wright's "Practical Poultry Keeper" says: With regard to feeding, if the question be asked what is the best food for chickens, irrespective of price, the answer must decidedly be, 'oatmeal.' After the first meal of bread crumbs and egg no food is equal to it, if coarsely ground and only moistened so much as to remain crumbly. The price of oatmeal is, however, so high as to forbid its use in general except for valuable birds; but we should still advise it for the first week in order to lay a good foundation."

We are obliged to differ from Mr. Wright as to oatmeal being an expensive food for chicks. It may look expensive to pay $4.00 a barrel (two cents a pound) for oatmeal for chicken food; but it goes so far we have found it a decidedly economical food. We use perhaps fifty dollars' worth of oatmeal a year and it makes about one-fifth of our chicks' food ration for the first three months of their life. Considered simply as a food ration it is economical, but when we consider that it is a good foundation for the future usefulness of the birds, and that a good foundation for chicks means eggs in the basket next fall and winter,—then we realize that oatmeal is a cheap food in the best sense of the term.

By the time the chicks are six to eight weeks old the principal dangers of chickenhood are past and the two different methods of feeding are inaugurated. The chickens intended to be raised for breeding stock are put out in the fields, where they have a grass run and free range. The chickens intended for market are kept confined in the brooder-house pens and yards and fed a slightly different grade of food. The principal difference is in increasing the amount of cracked corn and corn meal of the market chicks and cutting off the oatmeal, of course the green food being plentifully supplied and grit being constantly accessible. The chicks in the field intended for laying and breeding stock must have a liberal supply of nourishing, strengthening food, which will build up a strong, healthy and vigorous body, with stores of strength to lean upon when maturity shall come. The breakfast is bread crumbs, continued usually until the chicks are about ten weeks old, when they are graduated into a morning mash of cooked vegetables (which makes about one-third of the whole) and mixed meals, being equal parts by weight of corn meal, ground oats, fancy middlings and bran (or shorts); this is salted about as it would be if it were food for the table. The vegetables are potatoes, beets, turnips, carrots, onions,—anything in the vegetable line, thoroughly cooked and mashed fine, the mixed meals being stirred in until it is as stiff as a strong arm can make it. The breakfast in the morning is this mash; in the middle of the forenoon a light feed of coarse oatmeal, moistened; just after dinner a light feed of cracked wheat and about five o'clock whole wheat or cracked corn, one one day the other the next. About twice a week we have fresh meat, (butchers' trimmings), which are boiled and then chopped fine. This we mix with the oatmeal (about half and half) for the second feeding. We have also a bone cutter and twice a week the chicks have a good time wrestling and trampling over each other in their eagerness to get the fresh cut bone. Cut bone, if perfectly fresh and sweet, is one of the best animal food supplies that we have, but, if this is not available, meat meal or beef scraps should be mixed into the morning mash, about one-quarter ounce per bird per day, for young birds, increasing to about one-half ounce per day as they approach maturity.



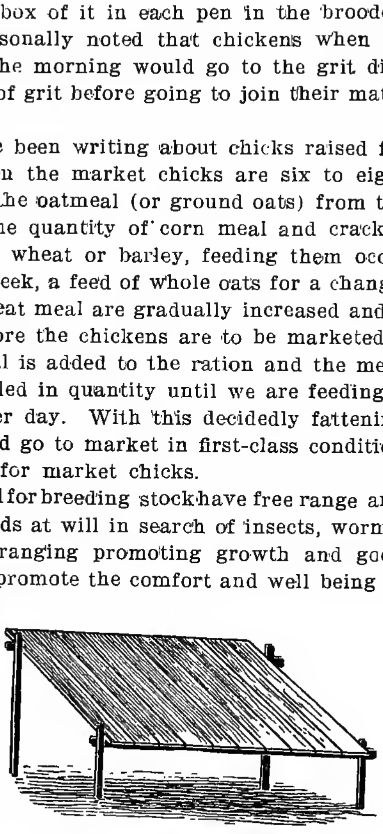
As a Shelter from Rain.

We vary the food ration continually within the range here described. For instance, one day the food will be mash, bread crumbs, cracked wheat and cracked corn; next day mash, oatmeal and chopped meat, cracked corn and whole wheat; the next day bread crumbs, cut bone, oatmeal, cracked corn, and so on. The intention is to feed only what the chicks will eat up clean and quickly; but we break the rule so far as the last feed is concerned and the boy goes around a second time twenty to thirty minutes after feeding, and if the food is all eaten up clean three or four handfuls more are put down so that all shall have a chance to "fill up" for the night. If a handful is left uneaten it quickly disappears in the morning, and as it is always dry grain it does not sour and there is no danger from leaving it out.

We have said nothing about fresh water because it goes without saying that fresh, clean water must always be accessible to the chickens. We water them three times a day, morning, noon and late afternoon; sometimes going around between whiles if it is hot weather and the chickens likely drink a good deal. The water dishes are carefully rinsed once a day and water which is fresh and cool is always accessible to them. Grit to grind the food is another necessity, a pan of which is placed near each food trough out in the field, or a small box of it in each pen in the brooder-house. We have personally noted that chickens when let out of the coops in the morning would go to the grit dish for two or three bits of grit before going to join their mates at the food trough.

Thus far we have been writing about chicks raised for breeding stock. When the market chicks are six to eight weeks old we cut off the oatmeal (or ground oats) from the food ration, double the quantity of corn meal and cracked corn, feeding also no wheat or barley, feeding them occasionally, say once a week, a feed of whole oats for a change. The corn meal and meat meal are gradually increased and a week to ten days before the chickens are to be marketed a very little gluten meal is added to the ration and the meat meal practically doubled in quantity until we are feeding a full ounce per bird per day. With this decidedly fattening ration the birds should go to market in first-class condition and bring top prices for market chicks.

The chicks intended for breeding stock have free range and can roam over the fields at will in search of insects, worms, etc., the exercise of ranging promoting growth and good health. We study to promote the comfort and well being of the chicks, believing that it pays to do so. The coops are kept scrupulously clean by being moved to fresh ground every other day, and every reasonable pains is taken to insure steady, continuous growth. It is the full egg basket in November, December and January, when eggs bring top prices and pay the creamy profits, that is being planned for and worked for in this good care and good feeding, and we have abundantly proved on our farm that this good care and good feeding pay richly. We cannot get a valuable thing for nothing; the good things of this world come by working for them, and the good profits that are to be gained in poultry raising have got to be worked for. With us the problem is early hatched pullets kept growing so that they shall come to laying maturity in October, and then kept laying. Our pullets are kept growing, and after they reach laying maturity are kept laying, by good care and good food.



A Shelter from Sun and Rain in the Field.

A. F. Hunter.

HOW TO USE OUTDOOR BROODERS.

Single Brooders Advocated—Crowding—Caring for the Chicks—Runs—Temperature—Cleanliness Essential to Success.

BY E. F. HODGSON.
Inventor of the Peep-o'Day Incubators and Brooders.

PROBABLY no one subject in poultry raising perplexes the amateur more than the problem of the artificial raising of chickens. There are many different systems in use on the large poultry farms of this country, and the more one looks about him to determine which system is the best suited for his particular needs, the more he is puzzled. Many persons start into this business with large ideas of what they are going to do, and they naturally want what seems to them the best and easiest way to raise their chickens on a large scale. Long brooder houses heated by hot water pipes attract their attention perhaps more than any other system. Although these brooding houses have been successful in the hands of many poultrymen, they have proved fatal in the hands of many beginners. Experience has taught us that if chickens are kept in small colonies they will do better than will those cared for in large numbers in one building. For this reason the small individual outdoor brooders are being extensively used and each year are growing more in favor among practical poultrymen. We find that as soon as the signs of spring appear the chickens must be allowed to run on fresh ground to obtain the best results.

Mr. E. F. Hodgson.

An outdoor brooder, with fifty chicks, moved to fresh ground once or twice a week or their yards changed to different parts about the brooder, is doing all that is possible to insure health in this direction. Of course the brooder should not be put out of doors until after the snow has gone. In our northern states the first of April is soon enough. A system now in use on many of our most successful farms, consists of using long or small buildings to run the outdoor brooders in during the winter, the brooders being put out of doors after the early chicks are brooded. In this way the house is left clear so that the early chicks may be raised to maturity in it, while the brooders are ready to care for the second and third lots out of doors. In the south no houses are needed at any time, and the chickens are better off without any other protection than the brooder.

Where small houses are used one brooder is placed in each house. After the brooder is removed the house is used to raise the chickens in and later on for a poultry house for the laying stock, the same applying to the long houses with one brooder in each pen. These pens are about eight to ten feet long by about five feet wide, the brooder being placed next to the alley-way, or walk at the rear, so that the lamp can be cared for and brooder cleaned without entering the pen. If there is no walk it is best to place the brooder near the center of the pen, as it will be easier to attend to it. With this arrangement the buildings are kept in constant use the year round, while a building used only for brooding purposes lies idle a greater part of the time.

When it is the object to raise laying stock no buildings are required to run the brooders in, as April is soon enough to start the chicks, and they are better off out of doors. A very convenient way to arrange a run-way or yard is to have it fastened to the front of the brooder and extend about twelve feet out. Most outdoor brooders are about three feet wide, so that a run this width by twelve feet long and two feet high is a good size and the top can be covered if necessary to keep off chick enemies. Another arrangement is to make sections of fencing about twelve feet long by two feet high. Four of these sections tied together at the corners will make a yard twelve feet square, which is generally large enough until the chicks are ready to leave the brooder. For the first three or four days a small yard should be made of three boards three feet long by eight inches wide and fastened to the front of the brooder, so that the youngsters cannot stray away from home. As soon as they become acquainted with their new quarters it can be removed, giving them the larger yard.

With the above system the problem of how to obtain green food for the young chicks is solved, but if it is not possible to allow them grassy runways, give them tender grass cut in short lengths or most any kind of cooked vegetables.

As we are naturally anxious to have our flock grow rapidly and mature into strong, healthy birds, we must look after their comfort continually. This close watching and care means more to our and their success than any other part of the poultry business. Unclean and overcrowded quarters are the two most common evils that confront the poultryman. If we could see the misery and filth in which the larger portion of chickens are raised, we would not be surprised that there are many failures. Even the most careful person is apt to let these apparently slight things go and is only aware how much better off he and his poultry are after he has faithfully cared for them.

If the brooders and coops were cleaned every day and fresh loam or sand sprinkled on the floor, it would do more good than many extra dollars spent for grain, for no amount of food can counteract the ill effects of unclean or crowded quarters.

Fifty chicks are all that should be put in any brooder, no matter how large, and about thirty in a coop after leaving the brooder. Both brooder and coop should be well ventilated, and so arranged as to be easily and quickly cleaned. The chicks should be removed from the brooders when four to eight weeks old, according to the weather, and colonized in small, well-ventilated brood coops, large enough to care for about thirty chickens until they are three or four months old. Then they should be removed to larger coops where they can roost. By using these small brood coops it enables one to remove his chickens from the brooder while quite young, leaving the brooder for the next hatch. There are many chickens lost each year on account of poorly constructed coops after leaving the brooder, and if more care were taken to prevent this the result would be more and better laying stock in the fall.

The correct temperature at which to run a brooder varies according to the different makes and it is best to follow the directions sent with the brooder you buy. Commencing at 95 degrees and gradually lowering to 80 degrees within three weeks is as nearly correct as can be given for general use, but it depends upon the position of the thermometer. Overheating or chilling is not good for the very young chickens, but a good brooder should be so constructed as to overcome these difficulties to a great extent. Plenty of clean water should be kept in a shady place during the warm days, and it is well to water them twice on hot days. Where there are no trees to furnish shade roofs should be made about six feet long by three feet wide of rough boards set on legs about two feet from the ground. This will be large enough to protect thirty good sized chickens.

If your coops have movable floors (as they should have) tilt them back during the sunny days, for it will dry and purify them as nothing else can. Feed the chickens in clean troughs large enough so the chicks will not crowd while eating. Throwing the food on the ground is a common method, but a poor one. Perhaps a board about three feet long by eight inches wide with lath tacked around the edges to form a dish is as good a trough to use for feeding young chicks as any, but care must be taken to clean the troughs every day and to have no food around to become sour. In other words provide clean, sweet food and water, and clean, well ventilated quarters at night, and you will be doing all that is possible to raise strong, healthy chickens.

FEEDING AND FORCING BROILERS.

Second Article by Mr. Duston—The Facts He Presents Have Cost Him Many Dollars in the School of Experience.

We will say, that we have decided on the variety that we will run; our eggs are as fresh as possible and of uniform size; we have put them into some well made incubator, and with proper care have gotten out a good hatch which came along promptly so that the morning of the twenty-second day we find the chicks nicely dried off. We now get our warmed, cloth-lined basket, with a heavy cover or shawl to prevent them getting chilled.

Right here I want to say, I believe more chicks "pass out," as our Christian science brethren would say, to the land whence no wanderer returns, from getting chilled in moving them from a warm, moist incubator on a cold day into the brooder, than most folks are aware of, and those little fellows you had such fond hopes of, but lost last winter with what you called bowel trouble or diarrhoea, were really chilled in being changed from birthplace to their temporary home.

Well, we have got them safely, we hope, into the brooder, which has been brought up to the temperature of the incubator. Of course we have placed our board in slides about a foot outside of hover, so that the babies can not get out in the long pen and not be able to find the way back and thus get chilled. Just bear in mind for the first week that to keep them warm is more essential than food.

The first day of their lives in a brooder has almost passed and they have not eaten anything but sand. Night has begun to come on and it is time to feed the hens, but, let us first scatter down for the babes a liberal supply of rolled oats, the white flakes of which will instantly attract them, and they are left to themselves. In the evening, as we fix the fire preparatory to locking up for the night, we look at them and are pleased to find them scattered all over the hover bottom, and their contented little "peep" is the last sound to fill our ears as we go out, and our mind is already filled with visions of juicy broilers and big breasted roosters and the perquisites thereunto attached.

The next morning as we turn out at daylight to see our orphans we find them calling for breakfast. We touch up the fire and then a feed of rolled oats is given them with a dish of warm skimmed milk. We use an old fruit can for this purpose with a notch cut in the edge. Partially filled with the milk and inverted into a saucer, this makes an excellent fountain for small chicks. A saucer not much larger than the can is best, then the chicks will not get "stuck up." The milk on the down will stick it together as bad as paste would. Some of the little fellows that would not eat will drink, so you save them along until they will eat.

That you will save more chicks by giving them warmed skimmed milk than by any other system of feeding grain, is my way of thinking.

We next powder some charcoal in a Wilson $5.00 mill and this is put into a dish and set in for the chicks to eat. We have found this an excellent regulator for very young chicks, as well as older birds.

We are now going to feed every two hours until our young charges are turned over to the butcher. Let it be done by the clock; you will then be more regular and can more easily even up the day.

For the first week you are limited to rolled oats, millet seed (which is a semi-green food) and cracked corn, run through a Wilson mill to make it fine enough, then sifted to save the meal, which, of course, is wasted by throwing it on the ground. We have kept milk before them all the time and have carefully washed the dishes twice a day, noon and night, as nothing gets any more filthy than do these dishes if left uncleaned, the fat of the milk, dirt and droppings all adding their mite to make it so, more especially as the chicks get older. Some think skimmed milk expensive to feed, but after trying it you will be convinced that the increased growth that comes from feeding it, gives you a good profit on it, and this is what we should always think of when weighing the cost of food. The real question is, can I get enough quicker growth by using it and give me a profit on it? For feeding choice "fancy" chicks I have heard it contended that whole milk was cheap to feed. I have been able to buy all the skimmed milk I want for 5 cents a can, of 8½ quarts to a can, and have used as high as twenty-six cans a day for broilers and roasters.

As we have put into each hover about one hundred chicks, we must see that the sand is carefully scraped off the top as often as necessary, probably twice the first week, which will be increased each week until about the third, then we commence to clean them regularly every morning.

We run the wheelbarrow into the walk and lift the hover, which is hinged against the partition so it is easy to get at. We take a small dust pan, or, if you prefer, make a scraper by driving nails through a stick something like a rake, only close together. Then scrape or rake the top off, going quickly from one to another.

For the first week we keep the board in the sides just forward of the hover, as stated before. Now the second week we will remove it and keep an eye on the chicks to see that they do not get lost and by staying away from the fire too long get chilled.

For this week we will feed about the same, only perhaps it will be well to try them on a little mash made up of one-third corn-meal and two thirds wheat bran, seasoned with salt and red pepper, just the same as though we were to eat it ourselves. Mix well and add boiling water. Don't put in enough to make it sloppy. Allow it to stand a short time, then feed. Not much will be eaten, but they will get so before the end of the week that they will look for it, as you feed your soft and hard grains alternately.

The third week we always settle down to our regular routine, to be continued until about ready to market. During the second week we have cracked some wheat in our mill, so have had that for an extra dish and a change, giving corn as a last feed generally. A good many feed cut or pin-head oatmeal to little chicks. This we have found to be a trifle pasty or gummy, and have dropped it, as more will get stuck up around the vent when this is fed than when not.

There is one thing that is absolutely imperative—that is, to get your chicks out on the ground. If it is bright and warm put them out for a few minutes when a week old. Don't let them stand "humped" up and shiver, but make them hustle around by driving, or feeding a handful of millet seed. After the second week they must go out every day unless it storms, no matter if it is zero weather. After you have tried it you will see how essential it is, for you will not keep them on their legs under such high feed in any other way.

As we enter upon the duties of the the third week we will now get our routine started and will see the chicks push along for the next five weeks, at which time we hope to see two-pound birds ready for the market, and get sight of the returns for our labor. The first thing in the morning is a feed of hard grain; then comes a feed of chopped raw potatoes. As the chopping knife and tray were too slow, we got an Enterprise mince meat chopper, had a new disc made with larger holes, about three-eighths of an inch in diameter, and ran the potatoes through that, catching in a pan the first and last to come out, as it is nothing but water. The other is the pulp. Now take their food dish and give each pen all they will eat. A little later we throw in a little cabbage, cut in strips, which they will seize and chase each other around for until it is all eaten.

This constitutes all the green food they have, except once in a while we may substitute onions in place of cabbage We have gotten our mash made for the day, and as 9 o'clock has come we will give our first feed of it for the day, only feeding what they will eat quickly. We feed on tin plates, about fourteen inches in diameter and a quarter of an inch deep, with a wide fold at the top. These can be readily cleaned preparatory to another feed by scraping with the feeding shovel, which is a small shovel about four inches across made of heavy sheet iron and a white iron handle. We have a pan to put the leavings in, if any. They go into the swill for the pigs. At 11 o'clock another mash, then the dishes are picked up, taken into the kitchen or cook room and washed.

Again at 1 and 3 o'clock we feed the mash, and if we have used good judgment we have had a hungry mob each feeding. If we have been liberal, we find they have left something each time and are not ready for their food. When this is so just scant them until they clean up each time and do it quickly, taking care you have enough for all. You will find the number of plates will have to be increased, as the chicks increase in size, in order that each may have a chance. At 5 o'clock or before dark throw down a liberal feed of cracked corn.

We follow this bill of fare for about four weeks. As we have crowded the chicks pretty well, by putting one hundred in a pen, we must take extra precaution against filth. At about four weeks of age a day's droppings are considerable on the floor of the pen, so the floor is now raked over each day and the collections wheeled out. For this we must use a loop-toothed rake.

We have by this time found our fountains small and easily tipped over by the chicks, so we have adopted new ones holding nearly two quarts, made of galvanized iron and cone-shaped on top to keep the youngsters from roosting on them, and instead of the saucer we use a small deep agate pan only a trifle larger than the fount. This we find to be very satisfactory, as the chicks can not put their feet in it.

To come back to the six or eight-weeks old chicks: We must now think of finishing them off. We examine them, weigh a few, calculate how much flesh can be made on them in about ten days, for as broilers, Boston has no use for anything over four pounds to the pair. We have fed so much bran that as we lay back the feathers on the breast we say, "they ought to have more color." How can we get it? We cast about for a way to get this. We know corn will do it, but we lose time if we drop off from soft feed to hard. The chicks won't grow as fast and we must turn them off as soon as possible to get the most profit from them. So we put into the mash all the cotton seed meal we can stir in and not make it "salvy" or "puddingy," as we call it. With a little treacle added we have accomplished the result.

We now have a fine yellow skin if we have not foolishly chosen a blue-blooded carcass, but any yellow-legged variety will succumb to the treatment. I would caution you against trying to feed this for too long a time, say more than two weeks, as the chicks will get cloyed by it and you cannot hold their flesh, to say nothing of making any, unless you can keep the appetites "up to the clip." This being such a high feed, it seems to become nauseous to them. One would find it difficult to keep them on their legs if it were fed from the first.

We have now "forced" the birds for eight weeks and have obtained what we set out for, viz: Two-pound broilers at eight weeks.

This has been successfully accomplished on our farm here, with White Wyandottes. We have not done quite so well with any other variety. As I stated in my preceding article, they will stand on their legs when Plymouth Rocks would be rolling on their sides with the same food.

We put up two pens of 110 each, and at eight weeks they weighed two pounds each, and a portion two and one-quarter pounds each under this system of feeding and almost the same treatment. By continuing the regular food we have made five and five-eighths-pound roasters at fifteen weeks old.

One thing more before closing: If you ship your poultry to market alive, and it travels twenty to thirty miles on the railroad, feed the night before, not too heavy, but some, as the birds will empty themselves in the night and on the journey. Give them all the water they will drink before they start on their funeral ride. You will thus save a portion of your shrinkage to nobody's injury, but to their gain, I believe, as you help retain the juiciness of the flesh. Some of these hints have been gained in the expensive school of experience, but if any earnest, honest poultryman can get anything of assistance from them he is welcome. As one word of caution, do not attempt to raise your breeding females under such hot-house methods, because you will surely sacrifice your size through early maturity, as after a period of forcing as given above it is no uncommon thing for pullets to lay at sixteen weeks, and we all know that is enough to stop growth. You may start your breeders in the brooder, holding off forcing foods, but get them out as quickly as possible.

The summing up of the discussion is, breed, feed and care. Let us not disdain to use the breed because it may be bred to "fancy points," as the fancy has given us our best and most practical varieties, and the nearer a typical bird we have in almost any breed, the better carcass we have.

PROFITABLE BROILER RAISING.

The Broiler Market, What It Demands—Best Breeds for Broilers—General Care—What and How to Feed—Method of Killing and Packing.

BY GEORGE H. POLLARD.

THERE is a strong desire in the heart of nearly every person to some time attempt the raising of poultry. This desire, when expressed in words, generally tends towards broiler raising, which, to most aspirants of the business, seems to be the beginning, if not the end, of poultry culture and its possible profits.

While the different methods of raising broilers for market have been pretty well explained and any one of these methods may, perhaps, produce good birds, there is yet always room for one more word on the subject.

There is no question that many of the failures have come through improper tools with which to work, and a general misunderstanding of the best means to the end, which in this case is the plump, yellow and juicy little chick which weighs from 1½ to 2 pounds when dressed or 2 to 2½ pounds alive. Heavier birds may be used, but these are the weights which are best suited to the demand and sell most readily, which means, of course, at the best prices.

Mr. George H. Pollard.

THE SECRETS OF GROWING GOOD BROILERS.

How to get these same plump, yellow chickens is the problem which we shall try to solve. Instead of beginning with the egg which is to produce the chick, we go further back, even back of the hen which lays the egg, and find the health and strength of her ancestry. In other words, we examine her family tree. If, on due investigation, we find the hen which is to lay our eggs is the offspring of some generations of strong, healthy birds, we may safely depend on her giving us the proper material on which to build our broiler structure. There never has, and never will be a successful broiler business built up on eggs from other than stock in perfect health and of strong vitality. The reasons are plain to see. In order to get your quick-grown, juicy carcass there must be a forced growth from the very hatching, and the chick must have the stamina and the vitality which alone comes through inheritance, and which enables him to stand the hardest feeding and keeps him busy and happy. The chickens from poorly-fed, ill-developed parent stock of hit or miss breeding cannot and will not fill the bill.

Next after strong, vigorous ancestry we look for shape and color. Shape first, as on shape depends the ability to lay on flesh in the right place and in the proper proportions. Any of the American breeds will answer this purpose. The oldest and best known is the Barred Pymouth Rock and they, when rightly bred for this use, are splendid birds. Strong, hardy and active, they grow quickly and are good feeders. The Leghorns, while advocated by some, are too small boned and too sprightly to get up to weight quickly enough. The Asiatics are generally too large framed and too angular when at the right weight to satisfy a fastidious market. The Wyandotte family as a whole provide the best means to the broiler. They are fine boned, yet with the plumpest breast development of any of the suitable breeds and have stout, wide-apart, yellow legs and yellow skin.

With these natural structural qualities the Wyandottes unite the ability to fully assimilate the strong feeding which goes with all attempts to produce suitable chickens for this purpose. Of the varieties of Wyandottes either the Buff or White would certainly be preferable to the laced on account of the darker pinfeathers found in the others. This same reason, aside from the fact of their longer establishment as a pure breed, would give the Whites the preference.

The White Plymouth Rocks are in nearly the same class, lacking, however, a trifle in breast meat. While some markets will accept white-skinned birds, it is well to bear in mind that all markets consider that the yellow-skinned birds sell the best, and that the difference between yellow legs and skin as compared with the white is often two cents to four cents per pound in value, which makes it of importance that a bird should be selected which possesses these characteristics. Uniformity in size and shape are also important factors and can only be secured by using some one breed which will reproduce with considerable exactness these qualities.

WHEN AND HOW TO HATCH BROILERS.

The question of breed and eggs settled, we get to the method of hatching, which in all cases where numbers are to be raised must always be with incubators, that is by artificial incubation. In order to get the cream of prices the chickens must get out in the late winter or early spring, and at these seasons the hens will not sit in sufficient number to provide means for incubating as many eggs as are needed for hatching. Aside from this fact, even if they would do so, we need them to produce the eggs to hatch and cannot afford to use their time in sitting.

If, then, artificial incubation is necessary it follows that the brooding must be likewise artificial. Any system of artificial brooding may be adopted, but some systems are better than others. While probably the greater proportion of broiler men use pipe houses there is a strong trend of opinion in favor of the individual brooders as being better adapted to the individual broods, and many claim to get better results than from the larger and more expensive pipe systems. We believe, however, that in warm weather small brooders and open fields are preferable to the larger house and fixed yards. Which system is to be used must be determined by the number to be raised and the amount of land available for the purpose. In these two, the incubator and the brooder, we have the backbone of the possibilities of successful and profitable broiler farming. Used with care and judgment we may expect them to do their duty more faithfully than the more animate parts of the outfit.

The incubators should be run as the instructions, seasoned with an occasional bit of common sense from the operator's own experience, shall direct. Extended directions on this point are unnecessary here. We may, however, say briefly that there is almost always a strong tendency to over-heat and over-crowd the chickens. We believe that as a rule fifty chickens are enough to be together, and fewer will do even better than this on general principles and with the average. ordinary care. The heat should not be over 95 degrees when the chickens are put under the hovers and should be reduced gradually as fast as possible, and still keep them from huddling and crowding, until the 70 degree mark is reached. An abundance of pure air is absolutely necessary. Sunlight in moderation, and exercise must also be had.

HOW AND WHAT TO FEED BROILERS.

There are very many ways of feeding, and probably there is no exclusive road to success in this direction. We, after trying various ways, have settled down to the easiest and simplest, that of soft food composed of two-thirds bran and one-third Indian meal, wet up with milk to a moist, crumbly consistency. The chickens are started on this mixture, to which is added about 10 per cent of fine grit or gravel. This is fed on boards or small troughs for the first forty-eight hours, after which we omit the grit, keeping, however, a constant supply by them.

In feeding the soft food the one thing to be avoided is sloppiness. It must be only moistened and not fed wet and pasty. They may have it before them at all times the first forty-eight hours; after this a pretty regular time of feeding, five or six times daily, all that they will eat clean of whatever food is fed, should be adopted. Provide an open air run if possible and exercise should be encouraged. Clean water should be before them at all times. A suitable water vessel should be provided after the first three days, and a small proportion, say five per cent, of fine beef scrap may be added to the bran and meal, which may then be mixed with water, either hot or cold.

If milk is to be had in plenty it is one of the best foods, and may be fed either whole or skimmed, sweet or sour, and should be fed in the soft food rather than by itself to avoid the dirty, sticky mess most chickens make when it is fed by itself. Increase the proportion of beef scrap gradually with their age, feeding only the best procurable. At three weeks they may have, once a day, a soft feed containing 10 per cent and one feed of five per cent, the balance being either cracked corn sifted fine, cut oat meal, rolled oats or cracked wheat.

Green food in the form of chopped rye or the like should be provided, and vegetables cooked or raw may be fed. Apples are especially enjoyed. Where they may be had at moderate prices they provide a tasty delicacy for the little birds. Cleanliness is absolutely essential. Nothing is better than some inches of fine sand or gravel for a floor. Chaff from the barn may be given them for scratching and they will eat many of the seeds and bits of hay. Anything which will keep them lively and healthy is good and anything that makes them lazy and indifferent is to be avoided. While many make fussy plans of feeding, important parts of the process of broiler raising, we have found that abundant quantities of common foods intelligently fed and a supply of clean, pure water are all that is really necessary.

IMPORTANCE OF BEEF SCRAP FOR BROILERS.

The proportion of meat scrap and ground bone which is fed has much to do with quick growth and final results. As much of these two should be fed as the birds can readily assimilate. A constant oversight is necessary in order that it does not cause looseness and scouring. At the very first symptoms of these troubles the animal food should be withheld or fed in less quantities for a day or two. As the chick grows, less bran may be fed and a food composed of equal parts of ground oats and meal may be used a part of the time instead. The bran gives a less attractive color to the skin.

When nearly ready for market the bulk of the food should be of Indian meal and scrap with cracked corn as a hard grain. Liberal quantities of corn and a grass run will always make the yellowest skins and legs. When too early for grass, rye may be had if provision has been made the previous year for its growing. A very small plot of ground wil produce enough for quite a large number of chickens.

When the chickens are up to weight and ready for market they should be kept for twelve hours without food and then killed. They should be killed by bleeding from the mouth and dry picked. Before the animal heat begins to lessen pick the body and neck clean, and the wings to the second joint. Leave the head on and the entrails undrawn. Cool in water, iced if the weather is warm. Before shipping hang by the legs until dry. Pack closely in boxes or baskets, using nothing between except it may be clean brown paper or cloths. If the stock is good, and it has been properly prepared, the returns in nearly every case will prove satisfactorily profitable.

We add a table showing the Boston prices for the three years, at different seasons:

BROILERS.

	1897.		1898.	
	First Two Weeks.	Second Two Weeks.	First Two Weeks.	Second Two Weeks.
January	....	.....	.25 to .30	.30
February	....	....	.25 to .30	.33
March	....	....	.30	.25 to .30
April	.45 to .50	.40	.35	.30 to .35
May	.30 to .35	.28 to .30	.30	.28 to .30
June	.28	.22 to .24	.25	.24 to .25
July	.20	.16 to .18	.24	.16 to .18
August	.15	.13 to .14	.16	.14 to .15
September	.14	.13 to .14	.14	.14
October	.13	.14 to .15	.14	.14 to .15
November	.13	.14 to 15	.15	.15 to .16
December	14	.15 to .16	.15	.15 to .16

	1899.	
	First Two Weeks.	Second Two Weeks.
January	.15	.18 to .20
February	.25 to .30	.40
March	.40 to .45	.40
April	.40	.40
May	.35	.33 to .35
June	.32	.25
July	.21	.18 to .20
August	.18	.14 to .15
September	.16	.14 to .15
October	.13	....
November	....	....
December	....	....

INCUBATORS ON THE FARM.

What Can be Done with Incubators and Brooders on the Ordinary Farm and How to Do It—A Start Should be Made with One or Two Machines—How to Proceed.

BY G. A. McFETRIDGE,
Vice President of the Star Incubator and Brooder Co.

INCUBATORS deserve to be called the farmers' friend as well as the grain drill, harvester and thresher. They are indeed worthy to be classed with the best implements. It has been fully demonstrated that the incubator hatched chicks are the strongest; it is also an indisputable fact that a greater percentage is obtained from eggs placed in an incubator than from those placed under hens, to say nothing of the endless trouble the hens give. Every farmer, it matters not how busy he may be, can find time to operate at least two or three incubators. All the time required to attend to three machines will not exceed fifteen minutes morning and evening. We will allow that the three machines will hold one thousand eggs all told. Now then we will set the same number of eggs under hens, giving fifteen eggs to each. It will take sixty-seven hens to cover them. The feed for the sixty-seven hens for three weeks will cost $3.92. Suppose you break the same hens from sitting by putting them into wire coops fastened to the wall of the hen house, without a mouthful of food, but plenty of fresh water, for three days. Let them out on the third day just at roosting time or about an hour before, and let them hunt for food the first night. Afterwards feed them with the rest of the flock. It will take three or four days before they get filled and then they will start right to laying and by the time the hatch is due they will have laid one thousand eggs which at two cents each will amount to $20.00. Add to this the cost of feed, $3.92, making a total of $23.92. So much for cost of feed and lost time while hatching. Repeat this five times, which is about the usual number of hatches run through an incubator in winter and spring, and it will foot up to $119.60. The above figures are not at all exaggerated. You must let a hen sit at least one week before any eggs are put under her. But if she is taken in hand the first night she sits on the nest she can be broken from her broody spell by the end of one week.

Mr. G. A. McFetridge.

Incubators do not require an expert to run them since the most puzzling part of the operation, the moisture question, is made plain for all time. Since the moisture can be regulated to a certainty in all altitudes and under all conditions of dry and damp quarters, the incubator may take its place among the honest machines which can prove beneficial to the farmer.

A BROODING HOUSE.

I will briefly outline a course for the farmer to pursue. Chicks should be hatched in December, January, February and March for broilers. To accommodate them it will be necessary to have a brooder house. The accompanying cut, Fig 1, is of a good, cheap house, It should be built with a view to adding a few feet to it from time to time as the business increases.

This house should be fourteen feet wide—nine foot run, two foot brooder and a three foot aisle. The runs should be five feet wide. If you expect to run three incubators the brooder house should be at least forty feet long, thus giving room for eight runs. The heater house can go on the end of the brooder house. The heater pit should be five feet deep. A greater depth would be better rather than less, for the hot water will circulate much better when it has a good rise. The pipe should have at least an elevation of one-eighth inch to the foot from the heater to the farther end of the system. If only one incubator is used then the best plan is to use a portable sectional brooder with about three sections. Build the brooder house just as though you intended putting a heater in, then put the sectional brooder in the place where the pipes should go. Do not crowd little chicks or ducks; if you do death will thin them out until the right number is left. A brooder house must be dry. If the house is built at a time when the ground is wet it will require a long time to get it thoroughly dry.

Figure 1 is a side view of a brooder house showing five sections. To build this house use posts two feet long, set them five feet from center to center, making three rows of them, one row under the front, one under the roof nine feet from the front, and the other row five feet away for the back of the house. This gives you fourteen feet in width, there being nine feet in front of the middle row and five feet back of it. After putting the posts in the ground for the outside of the building (they should go down level with the ground), dig away so a one foot hemlock board will go down even with the tops of the posts. The posts should be set so as to allow two inches for the boards. After the boards are on lay a 2x4 flat on top of the posts even with the outer edge of the board, then use four foot posts in front and six and a half foot in the back. Comb over the center row of posts which rests on the posts in the ground. Divide the runs with one foot hemlock boards and let these boards extend to the alley which is three feet from the rear. Before putting these boards down bore holes for the pipes. Use one and a fourth inch pipes which take one and five-eighth inch holes. Make the holes five inches from center to center, rip the board through the center of holes the width of pipes and after the pipes are down nail the strips in place, which makes a neat job. Get the top of brooder as near the pipes as possible. The space under the pipes should not be less than eight inches. The holes should be bored one-half inch from the top of the board. Fill under the pipes with sand or coal ashes and before putting the chicks in fill in on top of the ground planers shavings, hay seeds, chaff or salt hay (any of the above is good), up to within three inches of the pipes, which will insure dry and warm brooders.

Hinge half of the brooder top for a lid or door; run wire from the front of the brooder up to a sufficient height and put a small gate in this, leaving the brooder on the alley side.

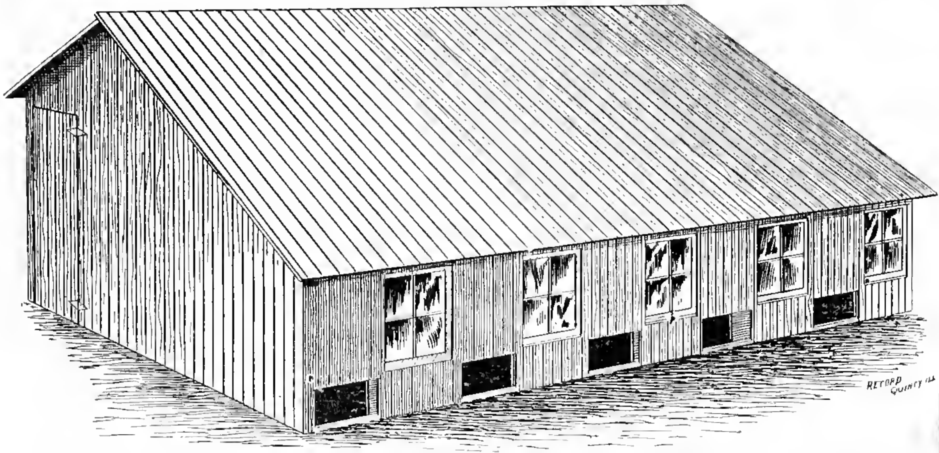


Fig. 1—Brooder House Recommended by Mr. McFetridge.

Put a 5x20 light in the back of each brooder and the chicks will be more contented. Put one window in each run so as it will slide on the sill. The sill is raised so that there is a ten inch space between it and the lower sill. This ten inch space is fitted with a sliding door about two feet long, for the little chicks to run in and out as is shown in cut. Figude 2 is a cross section of this brooder house and shows the interior arrangement, including the hallway, location of brooder and length of pen.

THOROUGHBRED MALE BIRDS.

As a rule farmers have fertile eggs. The only error they commit with the breeding stock is inbreeding. Why not send away and get some male birds of good stock which are off in some point which disqualifies them as far as the Standard goes, but which does not affect their standard as a flesh fowl? Any farmer who will try this method will surely be satisfied with the results. The chicks will be much stronger, the percentage of mortality will be much less and the chick will attain double the size at the end of the first three months over the inbred stock.

Give your breeding stock all the range you possibly can. An ideal place for hens is a clearing which has from three to ten years growth of timber. Thin out the young growth around the houses sufficiently to let the sun in around the building. When the business is carried on extensively the houses can be built within one hundred feet of each other. Then by the use of a temporary yard the hens can be broken to go to their own houses by keeping them penned in for the first two or three weeks. Then let them out, only for a short time at first, until they go back readily, and you will have no more trouble.

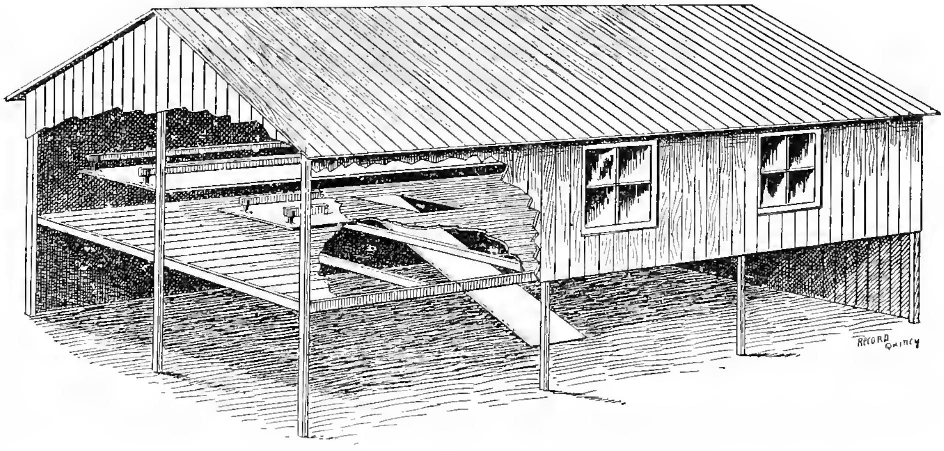


Fig. 3—Breeding House Recommended by Mr. McFetridge.

A HOUSE FOR LAYING STOCK.

The breeding house shown in cut is designed to hold from fifty to eighty hens. The house should be 14x16 feet. Use six and a half foot posts comb it in the middle roof with boards and cover with paper. There can be a pigeon loft in the roof if desired. Figure 3, on this page, shows the front of a house for laying or breeding hens. This house is set up on posts three feet above the ground, or in other words, the floor is three feet from the ground, making a basement for the hens. The open side is to the south, while the other three sides are boarded up and banked in terrace style to insure dryness. Make a door in floor for the hens to go in and out, and put only two windows in the upper part. This house can be built at any length, but fourteen feet is wide enough. Use six and a half foot posts. The perches can go in the back or through the center, but there should be a platform three feet wide and thirty inches high under the perches. Use two pieces of No. 14 hoop iron, bend them as shown in cut, for the perches to lie in. There can be a brace fastened to one end to hold them in place.

Figure 4 shows an anti-egg eating row of darkened nests. This nest box is made by using two one foot boards for the bottom and a one foot board for the sides. Nail the side boards inside of the top and bottom, leaving a space of twenty-two inches between. Divide the nests with one foot square boards, leaving the nest one foot in the clear. Nail a two inch strip on top and bottom edge of the partitions to hold them in place. The balance of the space is for an alley. These nests serve two good purposes, they stop egg eating and keep the hens out of sight while they are laying.

To get the best results from pullets they should be separated from the male birds at three months old or even earlier. Just as soon as you can distinguish the sex put them where they are to be wintered so that they will feel contented for a fretting hen will not lay. They must not be frightened. Give them their own way and stay out of the houses during the time they are on the nests. Construct their nests in such a manner that no one can see them while they are laying. Instinct leads them to lay their eggs in a protected place. Hens know that the eggs contain their young, which fact explains why they are so careful of them.

STARTING IN THE BUSINESS.

The question arises with the farmer, "How shall I start in the business?" First, buy a good incubator of one hundred to two hundred egg capacity and become acquainted with every detail. Also get a brooder, and by carefully studying the system you will soon learn how to operate three or four just as easily as you did one at the start. The best place to run an incubator is in the cellar of your house unless you build an incubator cellar similar to the house cellar, where the temperature is not likely to run up during the day as it does in an up-stairs room. Never set an incubator where the sun will shine on it, as that will cause the heat to run up. Never readjust the regulator for at least half a day after attending to the machine, as it will take fully that long to effect a change. When the machine is first set it will require twenty-four hours to get a stationary temperature. The thermostat will open the valve when the thermometer registers not more than eighty-five or ninety degrees, yet you must not interfere with the nut on the connecting rod for twenty-four hours unless the temperature goes above 102. I have seen the damper rise in three or four hours after the eggs were put in when the thermometer registered only 80. This is easily explained: the egg chamber is 102 while the interior of the egg, on which the thermometer rests, is only 80. You cannot be too careful in this respect for so many destroy the germs of the eggs before they even start, with excessive heat.

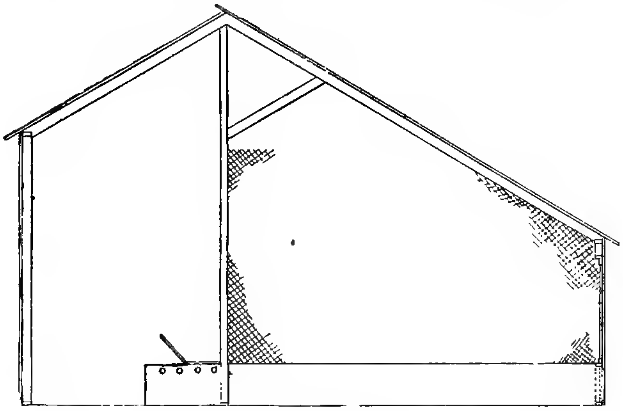


Fig. 2—Showing Cross Section of Brooder House and Interior Arrangement.

Keep the heat at about 102 for ten days, after that time it will not injure the eggs to go to 103, but they should not be kept at that degree constantly. Cool them by leaving the doors open a short time morning and evening. Most of these details are given in a book of directions sent with each machine.

After hatching, careful brooding for two weeks is the main point. It has more to do with the chick than even the choicest food. Stale bread soaked in milk and squeezed as dry as possible, is an excellent food. Feed the first time when the chicks are about thirty-six hours old. They should remain in the incubator until they are about twenty-four hours old, when they should be taken out and put in a warm brooder for twelve hours more. In the absence of a brooder put them in a flannel cloth placed in a box or basket near the stove so they can rest and sleep. Little chicks are often killed with kindness at the start.

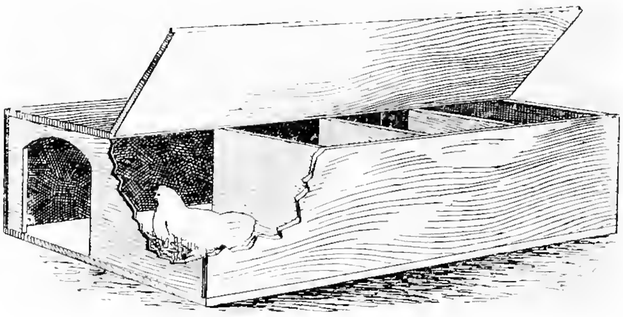


Fig. 4—Nests to Prevent Egg-Eating.

When little chicks crowd in a brooder they are not warm enough; if they are comfortable they will spread out over the brooder floor; if too warm they will come out of the brooder. Pay attention to these points and you will find it a pleasure to raise poultry artificially.

Do not condemn an incubator until you are positive the fault does not lie with the operator. Subscribe for as many poultry papers as you can find time to read; you will find them of great use. Some poultry papers are better than others.

I am well aware of the fact that farmers allow their hens to roost in the wagon house, stables, pig pens, and so on. To all such I will say, do not try to move them into a modern house after the first of October, for the change will surely give them the roup which will knock you out for the rest of the season. To make sure of winter eggs it is necessary to do all of the shifting in July. Hens will lay when they are contented, and fretting will certainly stop the formation of eggs just as much as cold weather will. Should you start into the business this fall, do not change your hens from their present quarters, but make the best of it until another season.

Use lice exterminator and make sure that they are all driven off the fowls and roost. Hens kept for laying market eggs should not have any male birds with them, as infertile eggs will keep much longer than fertile eggs. Do not crowd fifty hens into a house large enough for twelve.

POULTRY FOR MARKET.

Explicit Directions for Selecting, Killing, Dressing and Packing Poultry.

BY PHILIP QUIGLEY.

FROM the first of March to the first of November poultry should be shipped alive, or if shipped dressed should have sufficient ice in the barrel to prevent it from spoiling in transit. It would be safe to ship dressed poultry from November to March without ice, as during that time the temperature is lower.

Impress on shippers the necessity of permitting the entrails to remain in all poultry and game, with the exception of rabbits and venison; the entrails should be removed from the latter two animals.

We charge five per cent for selling goods and deduct the expressage, etc. Thus:

1,000 pounds, 10c		$100.00
Commission	$ 5.00	
Less express	10.00	
Net proceeds		$ 85.00

EXPLICIT DIRECTIONS.

Selecting.—Select nothing but well-fattened stock. Full crops are undoubtedly a great injury to poultry, and often taint the whole fowl, giving it a sour, bad flavor; besides, if it is kept from food twelve hours before killing, the food eaten before that time becomes fully digested and, having passed off, leaves the entrails comparatively clean.

KILLING.

Cut vein at back of throat through the mouth with a sharp-pointed killing-knite. Never cut this vein from the outside.

Immediately upon cutting vein, run point of knife through the roof of the mouth clear into the brain.

This causes "dropping the feathers," making them come off easily.

Soon as the knife enters the brain the bird loses all sense of feeling.

Begin plucking at once, being careful not to tear or bruise the flesh.

DRESSING.

Poultry should be dry-picked, not scalded. They should then be hung up by the legs or spread upon shelves in a dry place, but not in a draft where they will become "wind-dried." They should not be packed until the animal heat has had time to escape, or the entire bulk may become green and be unsalable. Care should be taken not to allow them to freeze before being packed, and it is much better to reach the market free from frost. The head and feet should be left on; they should be well cleaned, but the intestines should not be removed.

PACKING.

Barrels or boxes of the required size can be used, but the majority of the buyers prefer boxes, running 24 fowl, chickens, or ducks, and twelve turkeys, or geese, for the winter trade.

With the approach of warm weather, it would be necessary to ship dressed poultry in barrels, and thoroughly ice the stock to insure arrival in good order.

Each package should be numbered, and the net weight and the number of birds it contains, marked plainly on top or side, and advice sent by mail.

Poultry should be graded, and one size and quality of stock should be in one package, as a package of uniform stock will sell more readily than mixed lots.

Yours truly, Philip Quigley,
Commission Merchant.

Persons living as far west as Omaha have shipped dressed poultry to Mr. Quigley, while numbers of them livin Illinois, Indiana, Wisconsin and Ohio do so every year. When the Philadelphia market prices are two cents per pound higher than western prices, it pays a small profit to ship to Mr. Quigley. The two cents extra will pay the freight (ship in refrigerator cars by through freight) and leave a small margin. When there is more than two cents per pound difference in the prices all in excess of the two cents is clear gain. Said Mr. Quigley: "I have never yet had a spoiled lot of poultry shipped in here from the west. Dressed and packed as we advise and shipped in refrigerator cars it arrives here all right. It really pays best to ship all poultry dressed, for then there are no losses from deaths en route, there is no shrinkage, and where poultry is shipped long distances by freight it is almost necessary to ship it dressed. It is better, much better all round."

The first four months of the year Mr. Quigley handles an average of 10,000 of poultry per week. This past season he has received from the west a large number of capons. For these he paid sixteen cents per pound at a time when cockerels of the same age were bringing only five to seven cents, seven cents being the highest price obtained for them during the season. A number of men in the the west make a business during July, August and September of caponizing cockerels for farmers, these capons to be shipped to Mr. Quigley the following winter and spring when from seven to ten months old.

"The market," said Mr. Quigley, "prefers capons that weigh from six to ten pounds each, but we can sell all sizes. The prices for capons range with us from thirteen to eighteen cents per pound. We begin to have calls for them soon after Thanksgiving. About January 1 they sell at thirteen cents per pound, in February at fourteen and fifteen, in March sixteen to eighteen cents. You understand that capons fill in at the time of year when they are the only kind of tender fowl people can buy. The turkey season has passed by, poultrymen will not sell hens at this time and there are no spring chicks in market. This creates a good demand for capons and sends up the prices.

"Furthermore, capons are very tender and juicy eating, so that persons who buy them once buy again and again. I am a firm believer in capons and advise poultrymen to caponize, especially in sections where range is plentiful and food cheap. It will pay them a good margin over what they can get otherwise. I would advise western people to hold their capons over until March. Food for them is cheap in the west, as a rule, and the increase in prices will yield a profit."

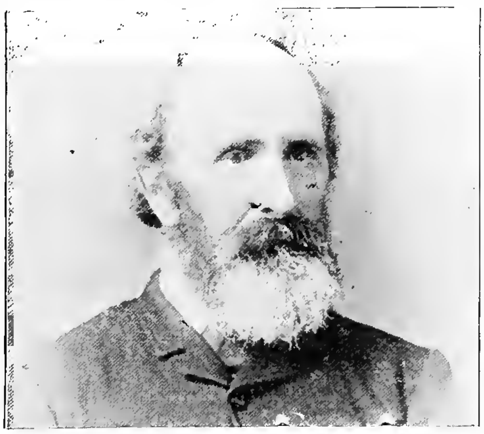
PEKIN DUCKS FOR PROFIT.

Poultry Raising Is Now a Trade—Operating Duck Egg Incubator—Proper Care of Breeding Stock—Formulas for Feeding Laying Ducks and Young Ducks.

BY JAMES RANKIN.

IT IS well known by this time that the poultry business is as much a trade as any other business, and a man in order to succeed must possess, at least, two traits to qualify him for the business—intelligence and energy. His buildings should be neat and commodious, constructed with a view of reducing the labor to a minimum, also of securing good drainage. Above all, start in with good incubators and good brooding apparatus. Secure first-class stock to start with. Debilitated, degenerate stock will never produce healthy young birds, and it is worse than useless to hatch thousands of young birds that come into the world with enfeebled constitutions and in no condition to live. But there are other sources of mortality aside from this. Cheap and improperly constructed incubators, with greatly varying temperature in their egg-chambers; defective brooders, which mean extremes of heat and cold for the young birds—all contribute their share toward the death rate.

I have never thought that the variety of food given was so responsible for the poultry-grower's troubles as the care, cleanliness and proper control of heat in both hatching and brooding the young birds. It is true that under proper regimen and diet young birds will grow faster, develop better and weigh more at a marketable age than if the food ingredients were not right, and the old birds will also contribute a larger number of highly-fertilized eggs when the food conditions are right.



Mr. James Rankin.

OPERATING DUCK-EGG INCUBATORS.

Highly-fertilized eggs should be used, if possible, as it will mean strong ducklings and more of them. See that the heat in the egg chamber is uniform. Use accurate thermometers, and place them on the eggs in the center of the egg chamber. Run them at 102 degrees the first two weeks and 103 after the animal heat begins to rise. The eggs should be cooled a little once each day after the first week, and longer after the animal heat rises. A little moisture should be used after the eighteenth day, ventilating a little more towards the end of the hatch. Observing these rules, with a good machine and good eggs, the operator should hatch from 65 to 70 per cent of all the eggs used.

Do not feed your ducklings till after they are thirty-six hours old. Feed four times a day and no more at a time than they will eat clean; in fact, keep them a little short, especially during confinement in inclement weather, as it is an incentive to exercise, which they need in order to assimilate their food. Do not put more than one hundred in a pen; seventy-five would be better. Bed the little fellows until ten days old, with hay-chaff or cut straw, then with sawdust (if to be had), as the latter is both a good absorbent and disinfectant. Keep the pens dry and clean, both outside and in. The welfare of the ducklings depends upon this. Be sure to give shade in warm weather. It is not necessary to keep water by them, but give all they will drink, while feeding. The birds should be ready for market at ten weeks old. Breeding birds should be selected from the early-hatched birds (I always select the largest and choicest), handling every one carefully. It is true that the early-hatched birds are worth more on the market, but I must keep them to breed from, as they will develop into larger and better birds than those hatched later, as the cool, temperate weather of the early spring will facilitate their growth and maturity much better than the extreme heat of mid-summer. The birds cost me more, but it is policy in the end, as they reproduce much sooner than the later ones.

PROPER CARE OF BREEDING STOCK.

The birds selected for breeding should be turned out to pasture or in large grassy lots, if possible, and fed on adulterated food. By this I mean bran, Quaker oat feed, with a little meal and grit. About November 1st these birds should be yarded for winter work. The yards should have been previously prepared for their reception. About August 1st, after the old birds are through laying and beginning to molt, they should be taken out of the yards and turned out to pasture. The yards are turned and sowed to barley or rye, which crop serves a double purpose—that of disinfecting the ground and giving a heavy crop of green food for the birds. This green food is cut fine and mixed in their daily rations. When the time comes to yard the birds, this crop has all been cut and the yards are in fine condition for them. These yards are one hundred feet long and the same width as the pens in the building. Whenever we have room, the yards are run out fan-shape, which of course makes them larger. Just before a snow storm we cut large quantities of rye and pile it up in a frozen state in some shady place where it can be drawn upon at will.

Should this supply be exhausted while the ground is covered with snow, we always have several tons of fine clover rowen, cured for the purpose. This, with a few hundred head of refuse cabbage, carries us through in good shape. I dwell particularly on this green food because it is one of the necessities for the production of strong, highly-fertilized eggs. Every one knows how necessary green food is for hens during winter confinement, yet it is even more essential for ducks. I mix fifteen per cent of this green rye, cut fine, with the other food.

I will now give my methods and formulas for feeding the young birds (at different stages of growth) for eggs, also for breeding birds.

FORMULAE FOR FEEDING DUCKS.

For Breeding Birds (Old and Young) During the Fall.—Feed three parts wheat bran, one part Quaker oat feed, one part cornmeal, five per cent of beef scraps, five per cent of grit, and all the green food they will eat, in the shape of corn fodder (cut fine), clover or oat fodder. Feed this mixture twice a day, all they will eat.

For Laying Birds.—Equal parts of wheat bran and cornmeal, twenty per cent of Quaker oat feed, ten per cent of boiled turnips or potatoes, fifteen per cent of clover rowen, green rye or refuse cabbage, chopped fine, five per cent of grit. Feed twice a day all they will eat, with a lunch of corn and oats at noon. Keep grit and oyster shells constantly by them.

For Feeding at Different Stages of Growth.—The first four days feed equal parts of rolled oats and cracker or bread crumbs, ten per cent of hard boiled eggs, chopped fine, five per cent coarse sand. Feed four times a day, what they will eat up clean. Brooder heat ninety degrees.

When from four days to three weeks old, feed equal parts of rolled oats and wheat bran, ten per cent corn meal, five per cent coarse sand, five per cent of fine ground beef scrap soaked, finely cut green clover, rye or cabbage. Feed four times a day. Brooder heat from eighty-five to seventy-five degrees.

When from three to six weeks old, feed equal parts of corn meal, wheat bran and Quaker oat feed, five per cent of fine grit, five per cent of beef scraps. Mix in green food. Feed four times a day.

When from six to eight weeks old, feed three parts corn meal, two parts wheat bran, one part Quaker oat feed, ten per cent of beef scraps, five per cent of grit. Feed three times a day.

When from eight to ten weeks old, feed two-thirds corn meal, one-third equal parts of wheat and bran and oat feed, ten per cent of beef scraps, five per cent of grit, oyster shells and less green food. Feed three times a day. They should now be ready for market.

We never cook the food for our ducks after they are a week old, but mix it with cold water.

I wish to emphasize several points again. Do not forget the grit; it is absolutely essential. Never feed more than a little bird will eat up clean. Keep them a little hungry. See that pens and yards are sweet and clean, for though ducklings may stand more neglect than chicks, remember that they will not thrive in filth. If any one fails in this business, it must be through his own incompetency and neglect. With us it is the surest crop we can grow. Independent of the elements, affected neither by floods nor drafts, heat nor cold, a concentrated cash product turned every three months, it makes the best returns of any crop on the farm.

Double Brooding House—North Side—Rankin's Duck Ranch.

BREEDING AND FEEDING PEKIN DUCKS.

As Practiced on the Atlantic Farm—Warmth of Brooders—Shade—What to Feed and When.

BY A. J. HALLOCK,

BROODING comes first, but is no more important than feeding. They must go together, for if either is neglected, it will be felt in every nook and corner of the farm and the hardest blow will fall on the pocket book of the owner.

As soon as the ducklings are thoroughly dry they are taken from the incubator and placed in the warmest section of the brooder, where the temperature under the hover is about 90 degrees and that of the room about 80 degrees. The pens in this section are 7x10 feet including the hover, and the hover is 2x7 feet. Three one and one-fourth inch hot-water pipes run through this brooder about six inches from the floor. The floor is earth and is covered with hay or straw to the depth of about one inch.

Fifty to one hundred ducklings are kept in these pens, the number depending upon the quantity of ducklings on hand. If it is mid-season and everything is full we put in the larger number; but if it is the first or the last of the season the smaller number is left in them. They are kept here from one to three weeks. The time depends upon the above conditions and the weather. If it is cold they stay here longer than in warm weather. In this section they have no outside runs and are not allowed outside at all, as it is too cold in the winter, and during the summer it requires too much attention to keep them from getting hurt by the sun.

From here they go to a room that is slightly cooler (70 to 75 degrees and with outdoor runs 6x50 feet. Here they are gradually hardened by having free access to the outdoor runs, as their next step forward is to the cold brooder. They are not forced to stay outside if the weather is not warm enough for them to be perfectly comfortable. When they show signs of being chilly they are immediately driven into the brooder, as they do not have sense enough to go in themselves. When in this section they are always fed outside unless it is very stormy. After they have been here from one to three weeks (the time depends on conditions before mentioned) they are placed in the cold brooder, or if the weather will permit they are given the water runs, which are 26x140 feet with one end extending about 40 feet into a stream of spring water. These pens hold one hundred and fifty ducks, and they have access to the water day and night in warm weather, but during the day only in April and May weather. And here their education is finished. When they leave here they go to the market or the breeders' pens.

It is absolutely essential to success to keep the ducklings warm and comfortable, and their quarters clean. Ducklings that are not kept warm enough cannot grow and have a thrifty, healthy appearance; they will be far from it. They will have, we will call it rheumatism for want of a better name. The symptoms are: The beaks get very pale and soft and grow faster than the ducks. They stand around in a listless manner with backs humped up and the down standing out straight. The feet and legs get colorless and stiff and in severe cases they lose control of them entirely. When in this condition the cheapest and quickest cure is a good sharp hatchet applied to the neck. When they have not had sufficient grit, and have indigestion, they will show some of these symptoms but not all of them. In fact, a duckling's down will always stand up when it is not perfectly well and happy. On the other hand, they must not be kept too warm; the extremes are to be avoided. We can have "no cast iron rules." It is necessary to exercise a little judgment. With a bit of close observation any one can soon tell at a glance whether everything is right with the ducklings.

Shade should not be overlooked. If the ducklings are not well supplied with it many of them will be killed by the sun if they are not carefully looked after and driven into the shade when necessary. Ducklings have a very poor supply of what is called common sense. They will sit down in a sunny spot and stay there until they are so overheated that many of them will die on the spot, and others get so weakened that they drop off in a day or two. It is here that a careful attendant will save many ducks. After they are four or five weeks old they will learn to find shade.

The next important item is the food. During the first week we feed equal parts of corn meal, bran, No. 2 flour and about ten per cent coarse sand or grit, thoroughly mixed with enough water to make it moist and crumbly. Feed four times a day—soon after sunrise, at ten o'clock, two o'clock and a little before sundown. The food is put on beef scrap bags. We find these are better than boards or troughs for the little fellows, as it is easier for them to get the food, it does not get scattered in the pen, and if there is any left it is easily cleaned off. When the bags get soiled they are washed. The ducklings have all the water they will drink with each feed. The troughs are large enough to furnish water to them for an hour after feeding without refilling. They are V-shaped, about four feet long and two inches deep.

The second week the ducklings receive the same grain ration with eight per cent beef scrap added, and if it is convenient to get some tender, green grass we make the feed about one-fourth of this; but unless it is tender and easily digested it is best to use none at all. After the fourth or fifth week and until the seventh or eighth week we feed three times a day the same ration with an increase of scrap to ten per cent. After the ducks are eight weeks old, if they are intended for market we feed five parts corn meal, one part wheat bran, one part No. 2 flour, one part greens with twelve per cent beef scrap. A box of shells or grit is kept in every pen. Each ration is thoroughly mixed with enough water to make it moist and crumbly. There are enough troughs in each pen for all of the ducks to get around at one time without serious crowding. Ducks of different ages are not allowed in the same pen, because the strong would trample on the weak and the result would be stunted ducks with but one meaning—no profit.

We have a regular time for feeding and when that time arrives all else is laid aside. The one rule on the Atlantic Farm that the men must not overlook is, that the ducks are first and all other work must be dropped at feeding time. When the ducks need any attention whatever, it is absolutely necessary that they have it, and it makes no difference if it be noon or midnight.

TO HATCH AND RAISE DUCKS.

Selection of Breeders the First Step—Fertility of Eggs—Incubating—Testing the Eggs—Feeding Young Ducks.

BY GEORGE H. POLLARD.

EXPERIENCE teaches that while it is one thing to hatch a duckling or a chicken, it is quite another thing to successfully raise it to maturity in health and strength. It has been said that a child's education should begin one hundred years before birth. To get good hatching eggs and strong, hardy ducklings it is necessary to begin at least two or three generations back in the breeding stock. Many blue days and restless nights caused by puny, sick chickens, and eggs that positively would not hatch, might have been avoided if reasonable attention had been given to the care and condition of the breeding birds. Exercise is the important point. It is the rule with all animal life that exercise conduces to vigor, and vigor means added transmission of vitality. Eggs from closely yarded and carelessly kept birds can not produce results which will justify the time and expense expended in the effort to profitably use them. Success may come for a season or two, but the end is disastrous, as many a would-be poultryman has learned to his cost. The first point then in incubation is that the eggs be from hardy, vigorous breeders kept in such a manner that they may have open air exercise, green range, a water-run if possible, and that they be so housed and fed as to retain, as much as can be, the stamina inherent in all fowls kept under natural conditions.

FERTILITY OF EGGS.

In breeding ducks—other things being equal—it will be found that a water range will conduce very materially to a greater fertility of the eggs, and to a stronger and more healthy germ. The extra early eggs run very infertile at best, and any considerable percentage of hatchable eggs must not be expected before the latter part of February or the first of March. We have lost the sale of a great many early eggs for hatching through making this explanation, but have generally gained a customer after the inquirer had tried some eggs from those who claim to produce duck eggs that will hatch well in December and January. There are various ways of figuring the fertility of eggs. Many sellers divide them arbitrarily into two classes, fertile and infertile, and of course this is exactly true, but there are often cases when ninety per cent of the eggs will be fertile, yet there will be a hatching possibility of not more than sixty or sixty-five per cent, sometimes even lower. This is due to the early death of the germ, which can hardly be said even to begin to develop before dying. While these may, strictly speaking, be classed as fertile eggs, practically they are worthless and serve only as a catch for customers who do not know. The safe way is to figure the percentage of strong living germs after the first test and use that as a basis for your expectation of good or bad results. Eggs that produce from sixty-five to eighty per cent of this degree of fertility, according to the season, are good, seventy to seventy-five per cent being excellent. Ordinarily it would be as well to look twice at an offer of over eighty per cent at any season.

Eggs should be carefully handled but that does not necessarily mean that we must fuss with them. Keep them as near sixty degrees in temperature as is convenient, and if they are to be kept many days they should be handled over once or twice a week or their position so changed that the yolk shall not remain in exactly the same spot. If not clean when gathered (it is hard to keep duck eggs perfectly clean, especially in wet weather), they should be washed in lukewarm water and in cold weather carefully dried with a cloth. In warm weather the water may be left to evaporate. Some operators condemn washing, claiming it destroys the natural coating of the shell and injures the hatching chances. We have not found it so, and believe nearly all extensive operators wash the eggs.

OPERATING THE INCUBATOR.

If they are to be hatched under hens there is not much to be said as to methods. Nearly every one has his or her favorite way and uses it with more or less gratifying success—when the hen is willing. If hatched in incubators there is much to say, and lots that has been said. Beginning with very little more knowledge of incubators than we had of electric motors, we got about as satisfactory results as if we had run against a dynamo on a wet day. There were as many different theories as operators, and moisture and ventilation were the questions of the hour. We began with four Monarch machines, large size. The first season we used the four pans provided for moisture, and introduced them with considerable precision. The result, while not satisfactory, was largely due to the poor quality of the eggs.

The machines were located in the cellar of our dwelling house, and the cellar was cemented and contained a boiler for steam heat, the steam pipes radiating in different directions. This dry cellar, we were told, called for more moisture than an outside cellar, uncemented and without the furnace. As we gained a little confidence in the value of our own headwork we began to question the need of so much moisture and dropped one pan, running only three of the four, at that time sent out with each machine. We knew that some of the experts said the moisture was necessary to prevent too rapid evaporation of the contents of the shell, and also to rot the shell to make it easier for the duckling to break out. When we investigated after each unsatisfactory hatch we found many shells packed full of apparently healthy and fully developed ducklings, which were unable to turn their heads or to make the slightest motion to release themselves from their prison walls. Reflection seemed to teach us that this was all wrong.

We still further reduced the moisture, and while the hatches, as before, were unsatisfactory, we found fewer packed shells and less ducks with bills protruding through the shells, hopelessly cast. Finally getting to the proper pitch of desperation we ran one hatch throughout without any moisture, and to our gratification found we had quite as good results as when we had used it, and we had saved a great deal of trouble in trying to guess when to put in the moisture and how much to use.

VENTILATION.

The ventilation gave us more severe wrenches, and we ran the gamut from shut close to wide open, and it did not seem to make much difference in results. We coud not find any one who could definitely explain the mysteries of ventilation and we finally settled down to running nearly wide open till pipping time and then closing the ventilators nearly shut, in order to retain the moisture which came from the newly hatched birds. This prevented the inner membrane of the shell from drying and sticking to the ducklings.

We have not felt it so very important that the temperature should be absolutely unvarying. We aim to keep it at 102 to 103 degrees, and if it runs to 105 at hatching time we feel no alarm. We once had a strong prejudice in favor of hot-water machines, but a few doses of Cyphers' incubators, taken at regular intervals, have removed this prejudice. We have found the almost exact temperature without care, and the relief coming from absolute inattention to moisture and ventilation is a very great advantage over anything we have hitherto known.

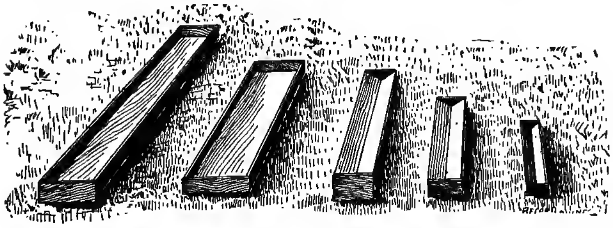
However, all rules have their exceptions and we believe no hard and fast system of procedure will insure perfect results, and that to be successful, brains must be mixed with the business.

TESTING THE EGGS.

We generally test duck eggs the fifth day, removing all infertile eggs and dead germs. The infertile eggs are perfectly clear inside, or show only a very slight shadow, which is the yolk. When the germ begins to develop there is a small dark spot on the inside of the egg which floats about as the egg changes position. This develops rapidly, and by the fifth day may be plainly seen as a dark central point from which radiate dark lines, resembling more than anything else a small spider in the center of a web. Some of the eggs will be cloudy and opaque; these are rotten and useless. Still others have a dense, black spot half as big as a dime, and some show rings or black or red. These are dead germs and should be removed.

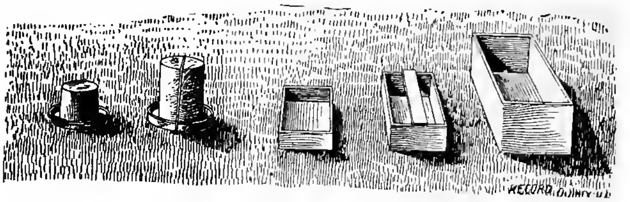
About the twelfth day we make a second test. A little practice will readily teach which are the growing germs and which are the dead ones to be taken out. The infertile eggs from the first test may be sold for culinary purposes and are equally as good as fresh laid eggs, the only perceptible difference being a slightly thinner yolk.

When the eggs begin to hatch let them strictly alone. Do not try to turn the pipped sides up, and above all do not open the machine every few hours to see how they are getting along, or to show some inquisitive friend how cunning the little dears look coming out of the shells. After the hatch is fairly well over and the ducklings nearly or quite dried off, open the machine and quickly take a tray out and cover with a thin woolen cloth. Look the eggs over carefully and if any are discovered cast in the shell, or with head lightly caught, break away enough of the shell to allow the little bird some freedom of movement and return the tray. Frequently these birds will break through and prove as lively as those earlier hatched. Do not, however, help too much. There is always a percentage of ill-hatched chicks that only live long enough to count one hatched and then die with their duty fully done.



Feeding Troughs for Pekin Ducks.

Leave the ducklings quiet in the machine from twelve to twenty-four hours after hatching; thirty-six hours will not hurt them. If the ducklings are to be raised in small brooders they should be warm and running properly a few hours before putting in the birds. Explicit directions are generally given with the brooders and we need here only advise the best procurable, and that there be not too many put in one brooder. Fifty is the limit for good results, and fewer will thrive even better than that number. We are well aware this advice will be wasted on many of our readers, and they will try the old scheme of putting more together till experience teaches them that it does not pay. An expert may, and often does, crowd many more into a pen, but the experienced eye is quick to detect the first sign of going bad and the fault is quickly remedied. Even then the chicks suffer from the practice and make a less perfect growth. The general conditions are the same in a piped brooder house as in a small brooder. There is simply more of it.



Drinking Fountains Used by Mr. Pollard.

The heat under the hover should be about 95 degrees when the ducklings are put under from the machine. The animal heat from their bodies will raise the temperature several degrees in a small hover. Keep the heat from 90 to 95 degrees for the first three days, after which it may drop to 85 degrees in cool weather and 78 to 80 degrees in warm weather. Ducklings do not require so much heat as chickens. The floor of the hover and pen should be littered with sawdust, fine shavings, chaff, or cut straw, or it may be covered with fine sand or gravel.

The little birds should be penned back near the hover at first, that they may not lose the source of warmth and get chilled. This we do by placing a narrow board across the pen about twelve or fourteen inches from the front of the hover. The second day move it a little farther away and so on until about the fourth or fifth day they may have the full run of the pen. Care should be taken that at night they go under the hover and do not bunch up in an outside corner until they are old enough to decide for themselves what is best. After a week or two, in warm weather, they may chose which they prefer. In colder weather it will be longer before they forsake the hover.

FEEDING YOUNG DUCKS.

There are various methods of feeding, either of which may be used successfully. We have put aside all the boiled egg and bread crumb formulas and feed simple, easily prepared foods, and get good results. Their first meal is a mixture of two-thirds wheat bran and one-third corn meal, into each quart of which we put a handful of fine gravel, and mix to a moist condition with milk—either whole or skimmed; or we add two well-beaten eggs for each quart of the mixture, and mix with water. They have this food before them at all times for the first three days, beginning as soon as they are put under the hover. It is fed in either small plates or troughs. See illustration. How it is fed does not so much matter.

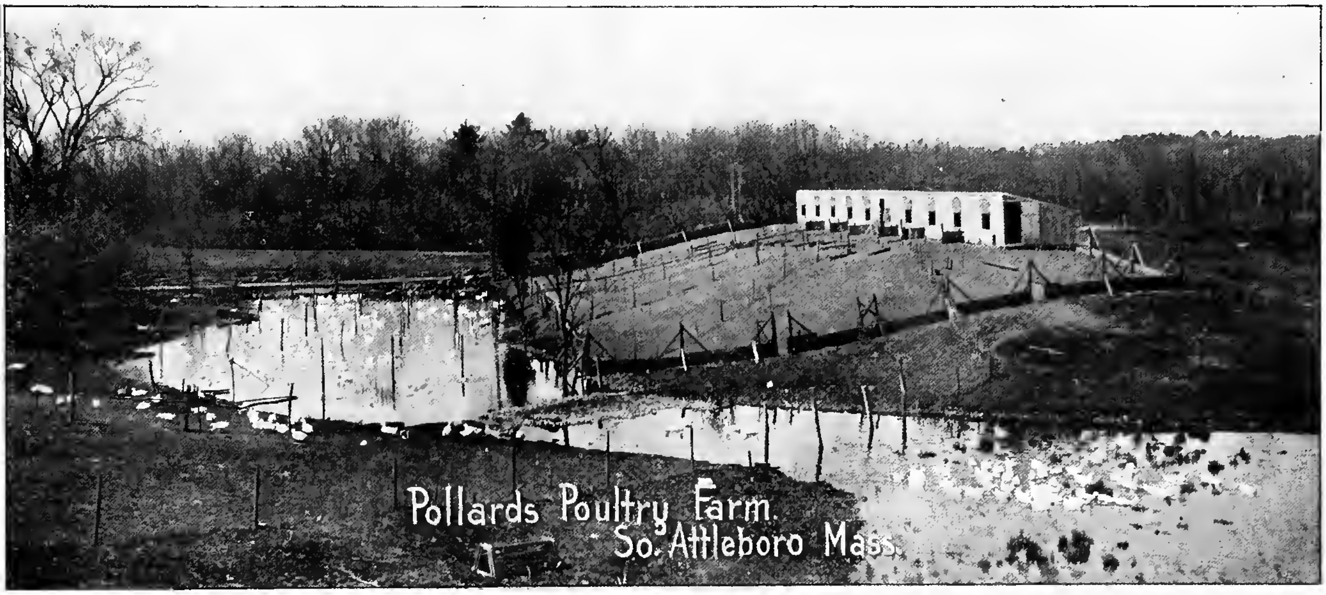
Water is before them in small fountains, cuts of which are shown herewith. Often if they are backward about beginning to eat or drink, if one or two have their bills gently dipped in the water it will start a general thirst in the whole flock. A little chaff scattered on the surface of the water will answer the same purpose, as in picking at the chaff they get a taste of the water. Many breeders feed only at stated times from the beginning, but we have found it saves time and trouble, and the ducklings do quite as well, when we leave the food before them. After the third day they are fed four times a day, rather more than they will clean up at once. From the first they have water during the night as well as the day. It is one of the prettiest sights of the whole business to see a string of downy, little, yellow chaps travel to and fro from the water fountain in a moonlit brooder building. They glide like quaint little shadows and converse in quiet little peeps of contentment.

The food is strengthened as they grow and when five days old they have an addition of five per cent of beef scrap and the eggs are dropped or the milk omitted. The beef scrap is gradually increased until at three weeks old they are getting ten per cent and at five weeks twelve per cent. The grain is equal parts bran and meal with enough flour added to make it hang together so as to save waste by throwing about while eating. Green food, such as grass, rye, clover, etc., is run through a clover cutter and mixed in the soft food, which is salted slightly and is wet up with cold water. After the fifth week they are fed three times daily and only what they will clean up at once. Gravel or grit is before them at all times and much care is taken that they may not be frightened or worried. Naturally of an exceedingly timid disposition, quiet is an essential part of the treatment for quick growth. The green food is not necessary except the birds are to be developed for breeders. Yet it may be used to reduce the grain bills. The ducklings need only drinking water, and if quick growth for market is desired they should not be given free water range, at least not before being fully feathered.

WEANING COOPS FOR DUCKS.

After the fifth week in spring and the third week in summer the ducklings may be removed to cold buildings, and will grow better without artificial heat. Of course this will not do before March or April. The houses need be only the plainest of sheds, but should be dry. After the first of June birds six weeks old may be penned in the open air with merely a shed roof, or brush shelter from the sun. From the egg up they need and must have convenient shelter from the sun's rays. Probably more young ducklings are lost from lack of suitable shade than from any other cause. Overheating causes leg-weakness, giddy, whirling spells, and spasms—and ends in the bird throwing itself on its side and dying. While the shade is an absolute necessity they must also have a chance to get as much sun as they require. They will suit themselves according to their needs where sufficient opportunity is provided.

While at first they are watered in the small galvanized iron fountains, when about three weeks old they are given a plain open trough, of a suitable size. As they grow, the size of the trough is increased. There are many patent appliances and more expensive methods, but for care and efficiency we have found no better way. Where the plant is large, water may be pumped by steam or windmills and conveyed in pipes to the yards and directly to the troughs. With the great majority, however, who raise ducks it must be a case of pumps and wells and carrying water, and these hints are rather intended for such than for those having extensive and completely equipped plants.



This photographic reproduction shows breeding house and runs for Pekin Ducks owned and recommended by Mr. Pollard. Each yard is part water, as he advocates letting breeding ducks swim. The division fences are about three feet high.

There should be yard room equal to thirty by fifty feet for each fifty birds to get the most out of them. Too much range is not desirable for market ducks, as they do not take on meat so rapidly. Many, about the seventh week, begin to make a gradual change in the food, adding a large proportion of meal. We have found we can get a maximum weight and size by using only the same food as fed after the fifth week, and the bird is not worried by changes of diet. We believe, however, that no one method can be chosen that will always be the best. Circumstances and conditions must determine which is best, and which is most avoidable in given cases.

Cleanliness is an important factor, for while ducklings will stand more filth than chickens, it will not do to presume on this point. The brooder pens must be kept clean and sweet, and as dry as possible. There will always be wet places around the water fountains and these do no harm but the dampness must not be allowed to spread over the whole pen, and the hover must be kept clean and dry. We find fine, dry shavings the best litter, but sawdust is fairly good. Chaff and straw get wet too quickly and retain the moisture too long. The yards should be kept decently clean, and scraping and sweeping may be resorted to to effect this end.

The one serious vice is feather pulling, and some flocks develop this mania to an alarming extent. We know of no way to effectually stop it when once begun. We try to divert their attention by giving them, if possible, a green run and sometimes we feed an extra allowance of beef scrap for a few days. It is generally more often developed in large crowded flocks than in the smaller ones. Of special diseases we know none, and raising ducklings may be classed as the simplest problem of the whole poultry business. Yet they must have care and attention or they will not thrive and they will leave a legacy of grain bills that will surprise the novice.

When carefully fed and cared for they will be ready for market at from ten to twelve weeks old, according to their feathering. If allowed to run over twelve weeks they become very pin-feathery and should be allowed to go till about the sixteenth week, when they will have their new feathers and will have gained from one to two pounds in weight. At ten weeks good birds will dress from ten to twelve pounds per pair and will average from ten and one-half to eleven pounds. Beware of the breeder who claims averages of thirteen pounds per pair and upward. Like the poet's maiden "He is fooling thee." They do not grow. An occasional pair out of a thousand may reach fourteen pounds, but there are many more that reach only nine pounds. The best and most desirable markets call for birds weighing from nine to twelve pounds per pair, dressed weight.

PROFITABLE BROILER RAISING.

A Pennsylvania Poultryman with Fifteen Years' Experience Produces Broilers in Large Numbers at a Handsome Profit and Does It Regularly, Season after Season—Description of His Plant.

BY A. F. HUNTER.

"BROILER raising as an exclusive business is practically a failure," says Mr. M. K. Boyer, in the September Poultry Monthly, and the dicta is all the more surprising coming from a man who has been looked up to as the "apostle" of the broiler business. Has he not published a booklet "All About Broilers," and does he not live in Hammonton, N. J., which has for years been looked upon as the great head-center of broilerdom? Can it be possible that the poultry world, at least so far as it put faith in broilers is to have its confiding faith rudely shattered? Here are Mr. Boyer's words:

"Broiler raising as an exclusive business is practically a failure. The amount of risk in buying eggs for hatching, the variety of stock hatched and the varied condition of such stock hatched, has given too much risk to broiler raising as an exclusive affair. But combine the broiler business with that of raising eggs for market and you have a combination that means a year round income, and the risk of loss is partly lessened. Selling eggs where prices are high and turning them into broilers when prices are on the decline, is a good rule to work by."

That is clear and comprehensive and as I have myself been guilty before now of declaring that there has been more money lost in broiler raising than there has been made in that branch of poultry work, I listened all the more eagerly to a friend of mine, Mr. C. E. White, as he told of a broiler-raising plant that he had visited (in quest of pullets) a few days before, the owner of which had marketed four thousand broilers this spring at a net profit of over twenty cents apiece, who had averaged to market a chicken for each two eggs put into his incubators, whose buildings were all home-made and unpretentious, and—"That's the man I've been looking for! Where is he? I'll go and see him," I interrupted. "His name is E. W. Twining and he lives at Yardley, Pa., up near Trenton, and he said he'd like to see you, when I told him you were here in Philadelphia," replied Mr. White, and the first Saturday afternoon that I could spare I took my friend with a camera along and went to Yardley in quest of a profitable broiler business.

It isn't a new broiler plant that has just started and everything about it "spick-spanny." On the contrary it is a dozen or fifteen years old—and is still growing. I was much interested to learn that Mr. B. Holmes, of the Poultry Monthly, had been at one time in charge of the plant, working there for two or three years, some dozen years ago, and going from there directly to the P. M. desk. In those days duck-raising was one of the branches attempted, but the plant has grown much and suffered alterations so that Mr. Holmes would hardly recognize it now.

ABOUT ONE ACRE OF GROUND.

One of the surprises there is the compactness of the plant, which occupies only about one acre of ground, directly in rear of Mr. Twining's farm buildings; all of it, the farm buildings and part of the pretty village being brought into the focus of the camera. The broiler plant proper consists of a grain-cook house of two stories, the second story being for storage of clover hay and grain; an incubator cellar with a double-pitch roof over it, each gable having a half sash window for light and ventilation; and eight or ten brooder houses of various lengths, but all of one pattern. They are twelve feet wide, seven feet high at the back, with a shed-roof sloping north, and are divided into pens 6x12 feet. Each pen has a window, 12 lights 8x10 glass, and a yard 6x12 feet in front. The partitions between pens are wire netting and wire netting frame gates give passage through from pen to pen; doors at each end of house give admission to either end at will.

The brooder house floors are all cemented and the hovers at the back (north) end of pens are unique. Mr. Twining told me they were of his own design. At the back, six inches from the wall is set an inch board and the space between the board and wall is packed with sawdust. Next are four one and one-half inch pipes, two flow and two return, but instead of being over the chicks' heads they are along the floor close against the back, and two above the other two. A board a foot wide projects forward from the board covering the bank of water pipes and a cloth fringe hangs down close to the board, which makes the floor of the hover, and which rests upon the cement floor. A half inch mesh wire partition is between the water pipes and the chicks; so there is no such thing as their coming in direct contact with the heated pipes; their bed room is 1x6 feet, is warmed for them, but getting up against the heated pipes is impossible. The board making the floor of the hover is, of course, loose, so it can easily be removed and cleaned.

These brooder houses are nearly all single-board walled and covered with Neponset roofing on the back side and ends; one or two of them are double-boarded on back with sheathing paper between. Nearly all of them have tin roofs, (on top of boarding, of course), but two new ones, just now being built have Neponset roofing on roof as well as back wall and ends; the fronts are all of one thickness of tongued and grooved boards. The hot water heaters are of a common pattern sold for small hot-houses and Mr. Twining said he built many small houses, of about sixty feet length, because the size of heater he liked wasn't large enough for more length of house, and he would rather not have several thousand chicks under one roof. A house of ten pens, sixty feet long, he thought, just about right. With 75 chicks in a pen that gave him 700 to 800 chicks in a house. The first house we entered was 66 feet long and had 800 chicks in it that had been taken from the incubators that day; there were about 3,000 chicks ranging from a day to six weeks old in four or five of the houses at the time of my visit, September 14, and in the incubator cellar we saw trays of eggs all ready to fill two incubators that night; and other incubators in full blast.

Feed and Mixing Room, Twining Broiler Farm.

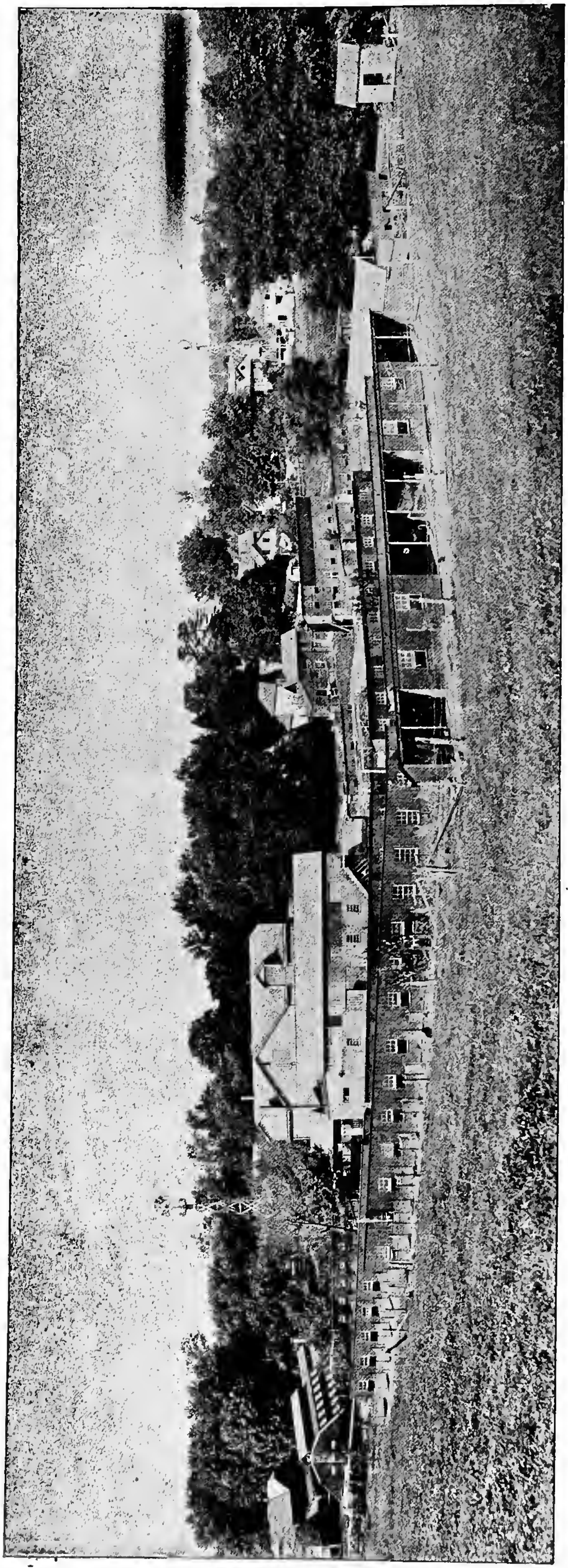
CARE OF HOUSES AND YARDS.

The chicks never go out of these pens and yards until they go to the picking house to be dressed for market, the limited range (6x24 feet) being ample for good health up to that size, and not sufficient to tempt ranging which would develop overmuch muscle. When a house is emptied of its chicks the pens are thoroughly cleaned up and disinfected with liquid lice killer or some other good disinfectant, but, to my surprise, there was no whitewash anywhere. A poultry plant without the traditional whitewash in evidence is certainly a novelty! The yards are spaded up and sown to rape each summer, which cleanses the soil and gives the next crop of chicks an excellent green food. When discussing brooders and brooding Mr. Twining told me he had one house 90 feet long which he found the heater insufficient for, so he had equipped those fifteen pens with Star brooders and ran the heaters in cold weather to take the chill out of the pens. The greatest trouble he experienced was in ventilating the houses in damp weather in spring. When that time came he cleaned up the pens every day, but in ordinary dry cold weather he only cleaned them out once a week. The furniture of the pens was of the simplest. A "V"-shaped feed trough about four feet long and two inches high for the food, a grit box for fine (chick size) grit and a water fountain. The pen floors are bedded with wheat chaff, than which nothing can be better; the second story of one building is used for storing this wheat chaff against the time of need.

The buildings are all home-made, Mr. Twining and his man having built them in the odd times between other (the regular) work; this, of course, means that they are not fancifully built, but are plain, simply constructed buildings, just such as any man who can saw off a board and drive nails could build. Although plain and simple they are substantially built on good stone foundations, and with only very moderate expense for repairs will last a life-time. Mr. Twining has had one man (a colored man) as helper for thirty years, but he died very suddenly last winter and Mr. Stephen Twining, the son, being about ready to leave school and wanting to take a hand in the chicken work, his father assented, and father and son now run the business. Mr. Twining, Sr., runs the incubators and the brooder house heaters, runs the engine which cuts the bone, grinds and cracks the corn and wheat, shells the corn, etc., and attends to the shipping market. Young Mr. Twining does the feeding, watering, etc., and the general brooder house work. When it is told that Mr. Twining also farms some 200 acres of rich Delaware River valley land, in two farms, keeps twenty-eight cows and ships the cream from their milk to an ice cream company (of whom he is one of the directors) in Philadelphia (he has the skim milk brought to the broiler plant to be fed to the chicks), it will be seen that he isn't suffering for want of something to do. There is a foreman to manage the farms, under Mr. Twining's direction, and they produced 600 bushels of wheat and about 2,000 bushels of corn the past summer. Not all of these crops is used on the place; in fact, Mr. Twining said he sometimes sold all of his wheat because of the bother of storing it in this humid climate; there is a grain mill right there in town and he can always buy wheat as he wants it. He uses what he wants of the corn and sells the balance.

POINTS ON PROPER FEEDING.

The illustration of the grinding room shows the boiler and engine, the grinding machinery, and in the foreground



The Twining Broiler Farm, As Described By Mr. Hunter.

close by the large doors, a "Dustless" corn sheller, not yet in place. On the right are grain bins and beyond them the pile of corn cobs used as fuel under the boiler. Mr. Twining said he found cobs an excellent fuel for making steam and that his power cost him comparatively little. It will be noticed that the many different parts of Mr. Twining's business fit to each other. The farms furnish the corn, wheat and skim milk for the chicks, the chaff from the wheat is stored for bedding the brooder house floors, the corn is brought to the feed room in the ear and is shelled there, the cobs being the fuel to make steam, by the power of which corn is cracked for the chicks or ground for food at the farms; the two wholly different lines of work help each other. This feed room is the first floor of a two-story building, the second floor being a clover storing loft and grain storage rooms; a clover cutter run by a belt up from the shaft below cuts the clover into one-quarter inch lengths. I noticed some clover meal and touched a sore spot. Mr. Twining had sent a clover meal concern an order for half a ton some months before. After waiting a long time and writing repeatedly he finally received half his order—and such stuff as it is! There is no more clover in it than there is in the wheat chaff on the brooder floors, and it isn't even good quality hay that it is made of. Mr. Twining will use cut clover from his own farm hereafter and would sell a small quantity of "so-called" clover meal cheap if he could find a buyer.

There were bags of prepared meat-food, which led to comments upon the excellent quality of meat-food, which Mr. Twining finds uniform in quality and of great value as a chick food. A small bin of cracked wheat attracted our notice and we asked if there wasn't considerable per cent of loss in feeding it. Mr. Twining thought not and said it all disappeared, and he thought the chicks ate the fine part and all. At any rate they feed it for but a few days, as the chicks could take whole wheat almost at once, if they had good, sharp grit, and expressed regret when I told him I had been informed that Mr. Orr had announced an intention to give up that branch of his business, as there was much work and bother and little profit in it. Of cracked corn Mr. Twining feeds a good deal, making four different sizes of it for chicks of different ages. That is one advantage of having power and machinery. One can make such things just as he wants them. Water is supplied from a windmill and tank and is piped to all parts of the plant, and in the scratching shed house (in the foreground of the illustration, there is a water-cock in every scratching shed.

The varying size of the buildings called forth remark and Mr. Twining called our attention to the seven pen brooder house, the first one built, some fifteen years ago, and still in active operation. That was one of the houses in use when Mr. Holmes worked there. The present two-story grain and cook house was a duck house in Mr. Holmes' day, and Mr. Twining said he had lifted it up twice. It was originally built with a roof sloping south and low front. He first lifted the roof up and made a grain and feed room of it, then lifted the roof a second time and put on a second story. The incubator cellar calls for no remark, it being exactly like hundreds of others. Mr. Twining has five Star hot air incubators, 400-egg size, and three Challenge hot water machines. The latter, he said, baffled him in warm weather. He couldn't ventilate them sufficiently to make them hatch well. In winter they hatched just as well as any incubator he had used. Mr. Twining asked me if I knew of any incubator cellar where the heating was by gasoline gas and said he was now negotiating with a man for the installation of a gasoline plant. I recalled that ex-Governor Morton's incubator cellar, at Rhinecliff, on the Hudson, was so equipped, and Captain Casey's at Katonah, N. Y. There would be no difficulty if proper precaution was taken to regulate the pressure so the gas wouldn't flare up and increase the heat.

Wanting to get the detailed figures of the spring output of broilers, the cost of raising, etc., Mr. Twining asked us to walk over to the office building, in front of the barn, and there showed me the figures in black and white.

WHAT IS FED TO THE CHICKS.

The baby chicks are fed five times a day upon H-O mostly, with a little cracked wheat and millet seed,—the cracked wheat being changed to whole wheat when they are about a week or ten days old, and finely cracked corn is fed after they are a week older; this brings them to three weeks of age. After that they are fed three times a day; a mash in the morning, wheat at noon and cracked corn at night, with a feed of cut fresh bone about the middle of the afternoon. The mash is made of either corn meal or gluten meal and wheat bran, with a ration of B. B. & B.—light at first and more of it towards finishing off. Green food they get each forenoon in the shape of lawn mower clippings when the grass is growing; at time of our visit in the shape of rape; and in winter, finely cut clover, steamed.

Feeding, Mr. Twining thinks, is the crucial point, and said a careless or indifferent feeder would do more harm and waste more food than the profits would come to. The test of good feeding is to keep the chicks just a little hungry, and the judgment of the feeder must be brought to bear. Not only does a careless feeder waste the food, but he knocks the chicks out of condition and checks their growth by cloying them, by undermining their appetite. If food is left before them all the time they will actually eat less, and make a slower growth than if fed judiciously and kept a wee-bit hungry. This is in keeping with Franklin's motto for good health, "Always leave the table with a little appetite remaining." It is certainly common sense with chickens, and probably quite a little of the loss in chicken raising is due to ignorance or indifference to that point.

Mr. Twining's decided success warrants us in giving heed to his methods, and many of us may profitably sit at his feet and absorb wisdom, for he completely negatives the whole of Mr. Boyer's assertion. Mr. Twining makes broiler raising as an exclusive business pay, and pay handsomely, and he does this while buying all his eggs outside—he hasn't a hen there on his place. True, the scratching shed house suggests that he keeps hens, and that house will be occupied this fall by some handsome Rhode Island Red and White Wyandotte pullets that we saw running about, and which he has raised this summer. It is true, however, that he marketed 4,000 (to be exact, 3,959) between April 25th and August 19th, and that he had about 3,000 babies, from a day to six or seven weeks old at the time of my visit. The table herewith presented gives the figures in detail, and is of the weekly returns from the commission men to whom the chicks were shipped. The first five lots were sent to a Philadelphia poultry dealer. Finding the price dropping very rapidly, Mr. Twining began shipping them to New York and got five cents better than the Philadelphia dealer paid. It will be noticed that there was a two weeks' interval when none were shipped, and then two hundred and forty went off in a week, and still they brought five cents better than before.

TABLE OF SHIPMENTS AND RETURNS OF MR. TWINING'S BROILERS.

DATE.	No. Chicks.	Returned.	Price Per Lb.
April 25	50	$ 25.00	.50
April 25	50	27.92	.48
May 3	50	23.01	.38
May 3	100	38.74	.35
May 8	50	22.19	.35
May 20	240	140.74	.40
May 27	200	119.67	.36
May 27	6	4.10	.35
June 3	201	123.68	.35
June 10	6	4.12	.35
June 10	252	145.33	.32
June 17	13	7.80	.32
June 17	250	132.44	.32
June 24	250	127.78	.30
July 1	209	109.85	.30
July 8	253	128.20	.30
July 15	205	98.40	.28
July 22	157	81.19	.28
July 29	274	102.18	.23
August 5	267	97.33	.20
August 12	432	133.16	.20
August 13	120	33.28	.20
August 19	270	94.02	.20
August 19	54	18.90	.20
Total	3959	$1839.03	

Average per chick, 46.45 cents.

The steady drop in price is normal, and is due to two things, increasing supplies and a falling off in demand. It seems odd, but is a fact, nevertheless, that at the swell hotels and clubs where the bulk of the choice breeders are eaten, the call for them is less frequent after a few weeks, the appetite of the epicure craves some other delicacy and he passes broiled chicken by.

The three small lots recorded were where neighbors sent in for a few pairs. In the matter of the 4,000, the books carry returns for 3,959, but a few pairs might have been given to friends or eaten at Mr. Twining's own table, and about five hundred likely pullets were saved to raise. We mentioned those Mr. Twining intends to keep, but some 300 had been sold and it was the advertisement of pullets for sale that took Mr. White there. There were 9,000 eggs put through the machines and a full 4,500 chicks raised, either to market size or sold as half grown pullets, or are there as well matured pullets now. Mr. Twining says it costs him twenty-five cents to raise a two-pound broiler, as follows:

Two eggs	5c
Labor	7c
Feed	8c
Picking	5c
Total cost	25c

At the prices he has paid for eggs they have cost him some less than 2½c each. He paid 30 cents a dozen for eggs in February, it is true, but is now paying 20 to 24c, and the average price for the whole 9,000 eggs upon which this account is based is nearer 25c than the 30c of the figures; still, a margin on the right side is better than crowding the other way. The picking is a high price, too. Four, three and a half and even three cents is paid for picking broilers. Commenting upon this higher figure, Mr. Twining said he would rather pay that price and have the chickens carefully picked, perhaps picking but 50 or 60 a day, than to have the man earn as much money by hastily picking 100 a day; it is quite easy for a picker to "skimp" his work, and the broilers be a cheaper looking lot in consequence, shrinking the price maybe three or four cents a pound. Quality pays, in broilers as in anything else, and the good quality of Mr. Twining's broilers often brought him three or four cents a pound above the highest market quotations of that day. The skim milk given them has a good deal to do with high quality in chickens, as one broiler raiser explained it, "milk gives them a kid glove like texture that no other food gives."

HATCHING AND MORTALITY PERCENTAGES.

Mr. Twining says that his hatches have averaged 65 per cent of the eggs put in the machines and his average of losses by deaths of all kinds has been 15 per cent. Some lots he wouldn't lose five in a hundred, others twenty to twenty-five, and the average of all is just about 15 per cent.

Some may be interested to know how he gets at the cost of feed and labor per chick. He took a time when all the houses were full, with the oldest chicks being shipped to market and newly hatched chicks going into the brooders and made a careful computation of a day's work, with quantity (by weight) of food fed, and believes he got everything into the calculation and that the figures are right. I mentioned that two new brooder houses were then finished, this means increased capacity and a slightly lessened cost per head, probably. They will have room for 8,000 chicks there at one time. If the feeding charge is no greater (as to labor) that for 5,000 or 6,000, obviously the labor charge per chick will be reduced one or two cents. Undoubtedly Stephen will have to "hustle" to feed and water 8,000 chickens, and if he keeps up to the present high standard of work maintained there he will be a remarkable man. The successful broiler feeder has to get up early and stick to it, they feed just as soon as it is light enough to see, they don't wait till after breakfast.

The question of hired help was brought up and Mr. Twining doubted whether a merely "hired man" would do the work as well or take the pains with it that would insure high success; his words were: "It pays to do your own work, because then it is well done," to which we could add—"Some men can't even do their own work well."

I asked Mr. Twining to what he attributed the large mortality in brooder chicks generally, and he replied that the bad feeding (mentioned above) was one cause and the management of the heat was another. Many people overheat their brooders and thus weaken (debilitate) the chicks, and others underheat them or are erratic as to heat. He begins at 90 degrees just as near that point as possible, and keeps close to that for a week; then drops to about 85 degrees the second week, 80 the third and so on down.

Most of the chicks he has raised were Barred Plymouth Rocks and he has found them very satisfactory; with the exception of their dark pin feathers they make a high class broiler. He is intending to try Rhode Island Reds and White Wyandottes, as with them he will get rid of the dark pin feathers; as he bought all the eggs he used he had to take what he could get. He paid about four cents above the market price for good average sized eggs, with the very small and slightly imperfect ones culled out.

Mr. Twining said he couldn't grow a two-pound broiler in eight or nine weeks, as some men do—on paper. It takes him about nine weeks to grow a one and a half pound broiler and eleven weeks to grow a two-pounder. We asked how it happened he didn't begin hatching till the middle of February last winter, and he smiled, "Well," said he, "there's a lesson in that, too. Stephen was interested in capons and wanted to try caponizing. So I bought some chickens for him to experiment upon, (we had none large enough), and they brought roup on the place. It spread to other chickens and to stamp it out, I shut down hatching, sold off every chick as soon as possible, cleaned up and thoroughly disinfected all the houses, let them stand idle for a month to be sure the roup was downed, and then we started up again. That's the "how' of this flock of 4,000 broilers that I am so certain of cost and profits on. We raised and marketed those between the starting up in February and the summer shut down."

It is obvious that but for that month or six weeks lost Mr. Twiuing would have made more money this season, because he would have raised 1,000 to 2,000 more broilers, and those at the time of higher prices. Costing twenty-five cents apiece to put in the market a two-pound broiler that sells for $1 pays 75 cents profit, while one selling at 40 cents (in August) pays but 15 cents profit. Five hundred per cent greater profit is quite a difference! Still, there is a good margin of profit in broilers at 20 cents a pound, provided they cost but 12½ cents a pound to raise; many a man would be happy if his business showed an equally large per cent of profit.

A. F. Hunter.

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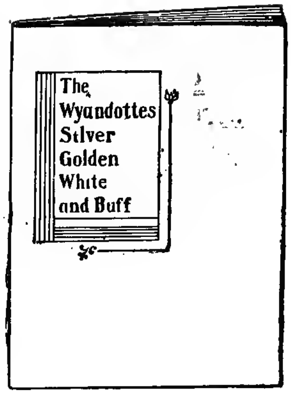
THE WYANDOTTES



The
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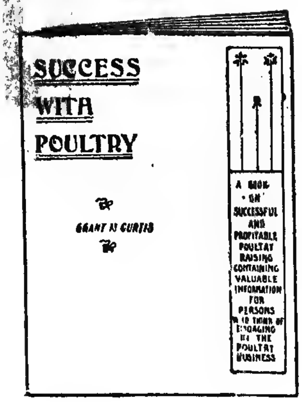
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